

Pre-fire forest management effectivity to decrease wildfire impact on soil properties in a Mediterranean forest

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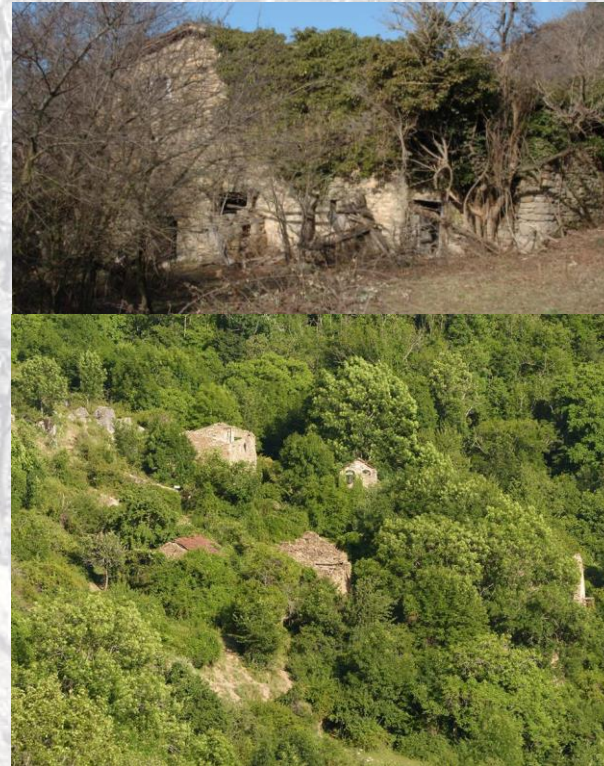
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MEDITERRANEAN FOREST



**RURAL
ABANDONMENT &
LAND USE CHANGE**

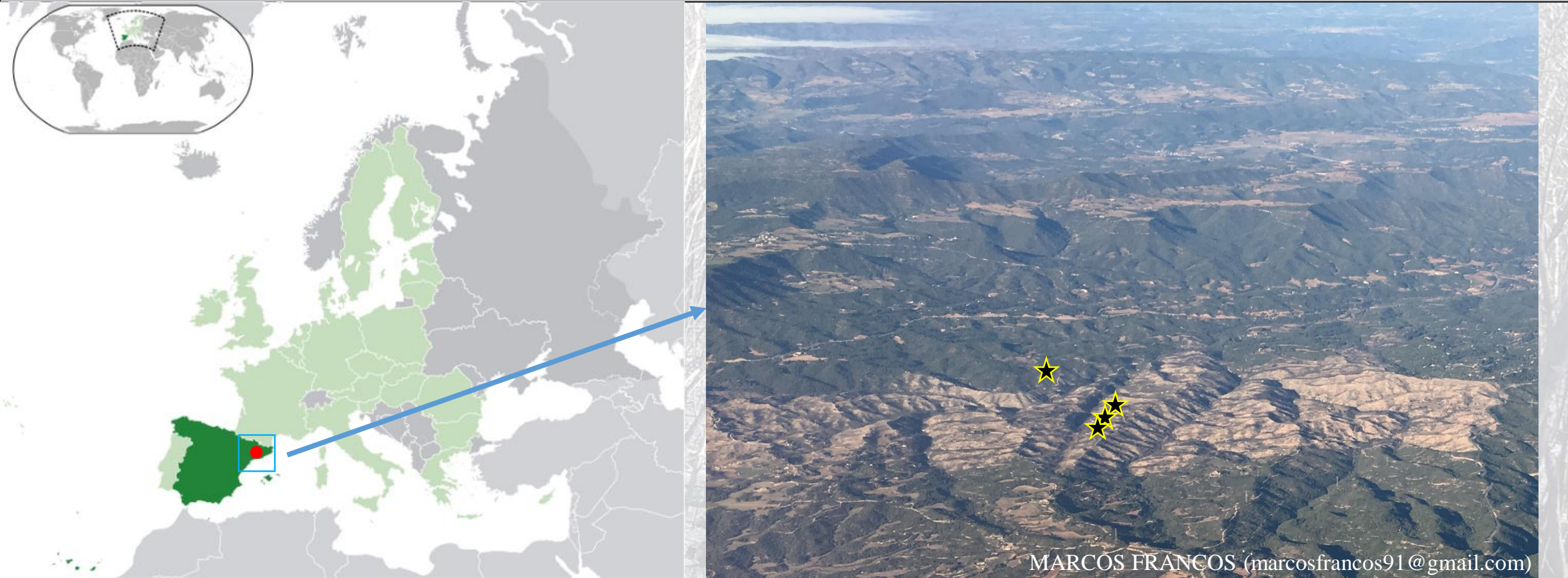


MANAGEMENT OBJECTIVES



The **aim** of this work is to **study the impact of a wildfire on three plots with different pre-fire management time**. Little research has been conducted into about this issue, especially in the immediate post-fire period, when the impact is most evident, and it is possible to evaluate the impact of pre-fire management and its effectiveness in reducing the impact of fire on soils.

This study of pre-fire management impact on soil properties is **essential to understand the effectiveness of forest management in areas**, such as Catalonia, that are prone to fire. The objective of this study is to examine the impact of pre-fire management on soil AS, TN, SOM, inorganic carbon (IC), pH, EC, extractable calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), microbial biomass carbon (Cmic), basal soil respiration (BSR) and C/N ratio.



- The study area is located in **Ódena**, Barcelona ($41^{\circ}38'42''$ N - $1^{\circ}44'21''$ E; 420 m a.s.l.) in **North-East Spain**.
- A fire broke out in El Bruc, on 26th July 2015 and affected a total of **1.274 ha**.
- Predominant **vegetation** of *Pinus halepensis* Miller, *Pinus nigra* Arnold and *Quercus ilex* L. Understory vegetation was mainly composed of *Pistacea lentiscus* L. and *Genista scopius* L.
- The forest had last been affected by **wildfire** in 1986 and again in 2015.
- The **geological substrate** is composed mainly of sediments originated from Paleozoic shale (Panareda-Clopés and Nuet-Badia, 1993). **Soil** is classified as a Fluventic Haploxerept (Soil Survey Staff, 2014).
- The mean annual **temperature** of the study area is 14.2°C and the mean annual **rainfall** ranges between 500 and 600 mm.

Pre-fire Management



Leire Miñambres. 23 May 2015



Leire Miñambres. 23 May 2015

The management treatment involved a **clear-cutting** operation, leaving **1,000 trees per ha** and leaving the **cut vegetation over the soil** surface in stems no taller than 1 m. In the case of the trees that were not felled, up to a third of their branches were removed. The good waste was cut to a height of 1 meter, the wood being of fine to medium thickness.

Experimental design and sampling

CONTROL



Study areas	Years of fire/s	Date of management
Mgmt05	1986 and 2015	2005
Mgmt15	1986 and 2015	2015 (2 months before fire)
NoMgmt	1986 and 2015	Not managed
Control	1986	Not managed

9 topsoil samples (0-5 cm), giving a total of 36 in each sampling campaign
3 sampling campaigns: 2, 10 and 18 months after wildfire

1st Sampling Campaign



Managed in 2005



Managed in 2015



No Managed

2nd Sampling Campaign



Managed in 2005



Managed in 2015



No Managed

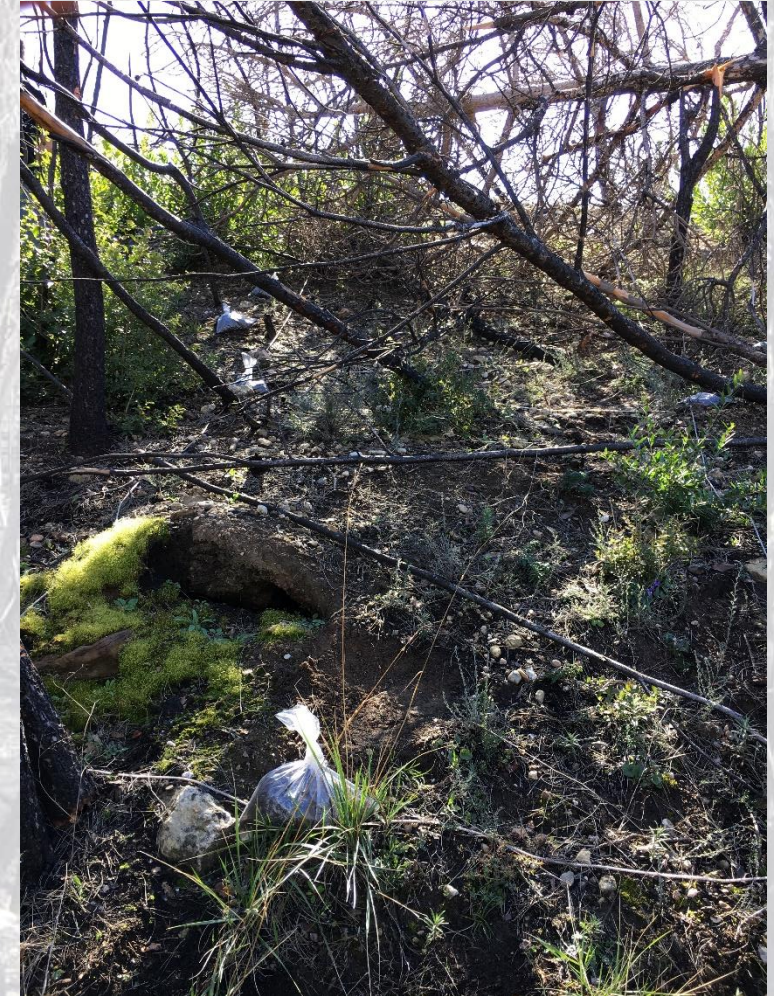
3rd Sampling Campaign



Managed in 2005



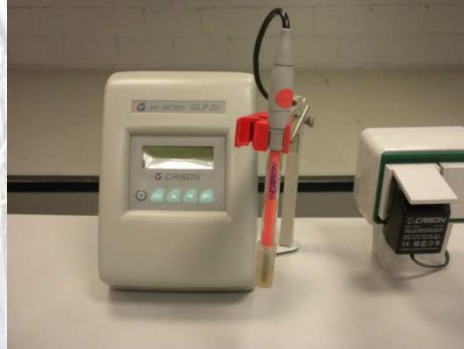
Managed in 2015



No Managed

Laboratory methods

Aggregate Stability



pH

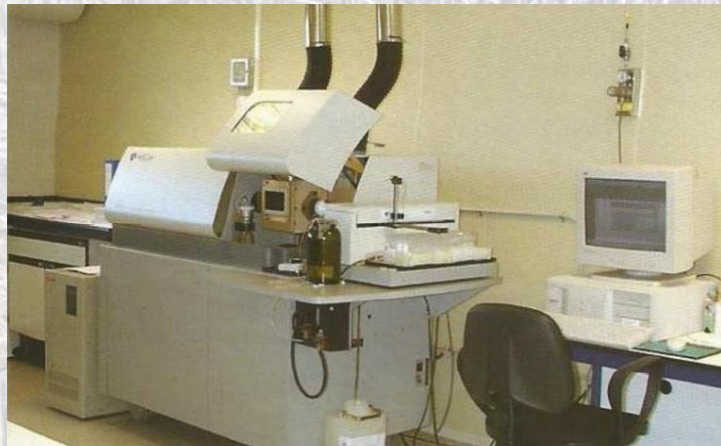


Electrical Conductivity



Inorganic Carbon

Soil Organic Matter



Exchangeable bases: Calcium (Ca)

Magnesium (Mg) Sodium (Na)

Potassium (K)



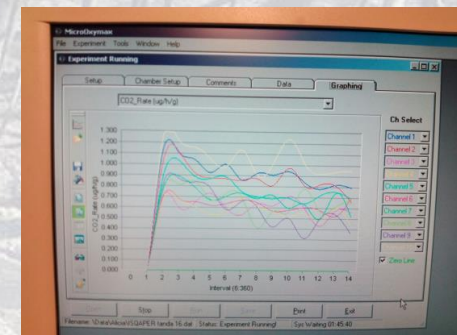
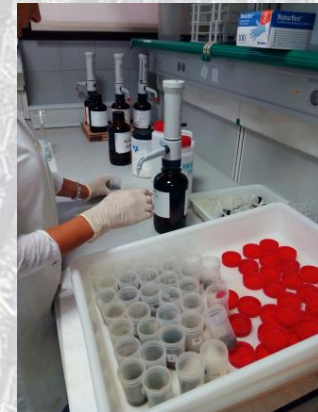
Total Nitrogen (TN)

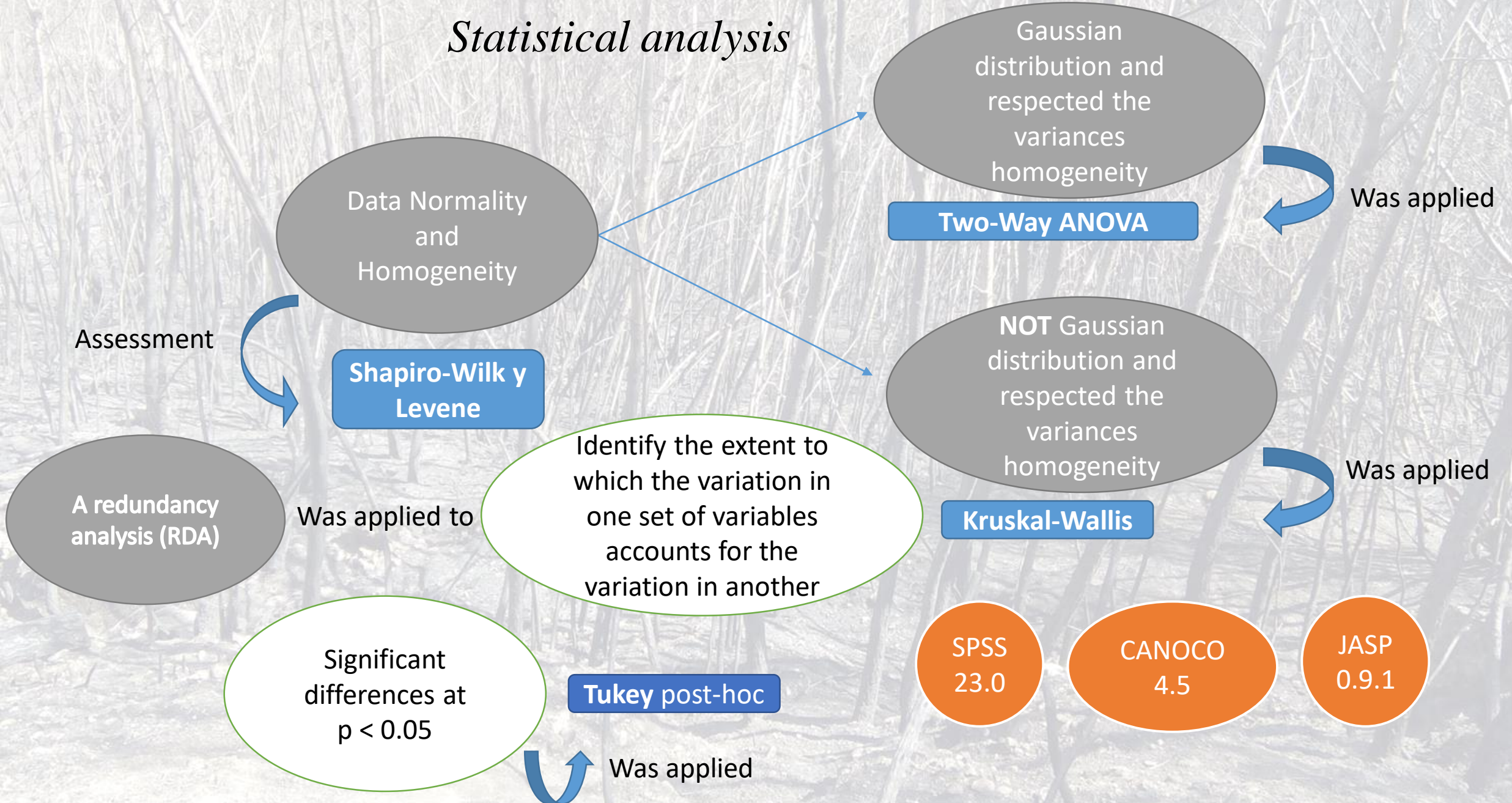


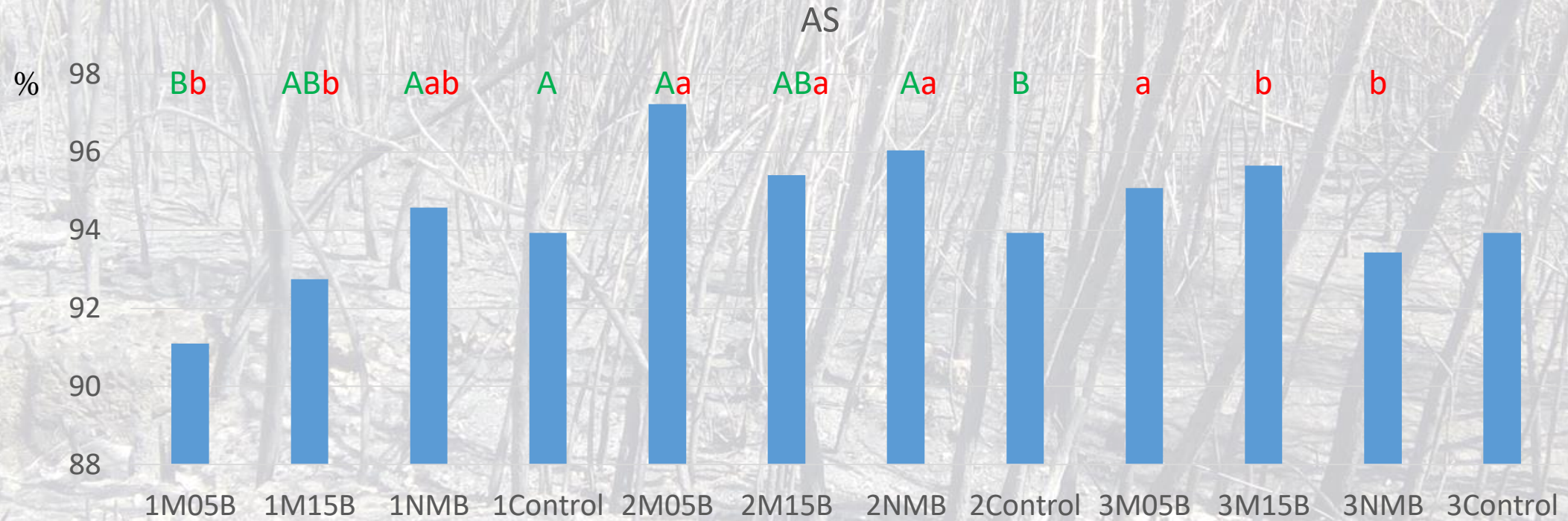
Cmic

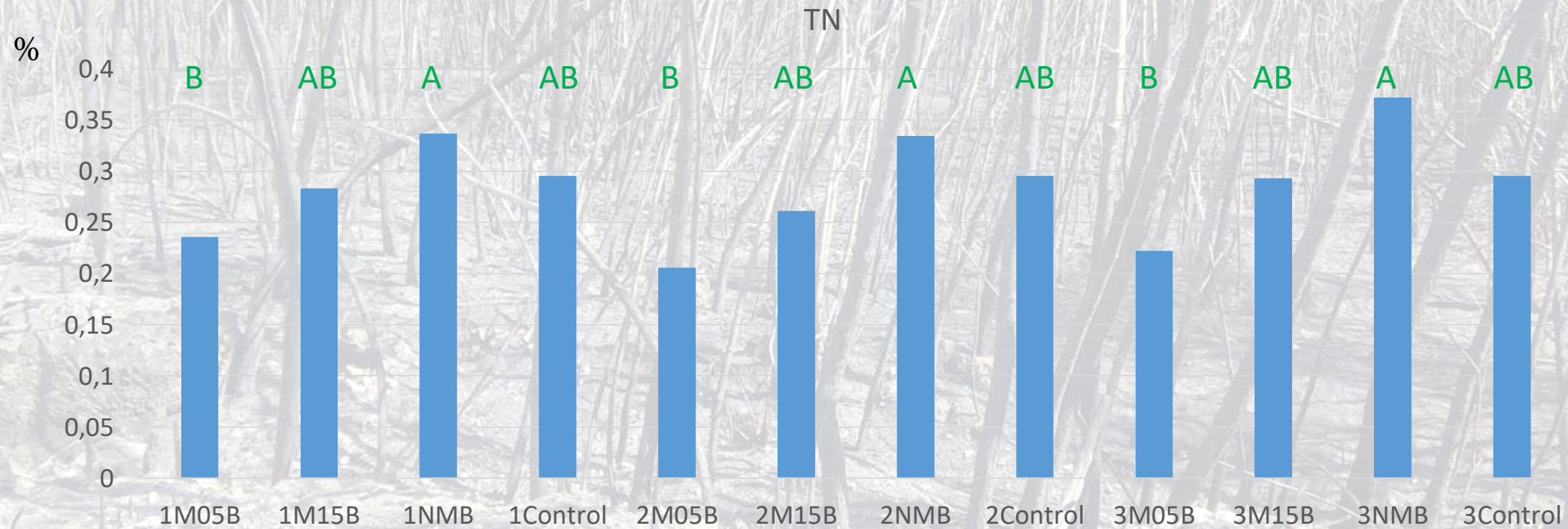


BSR



Statistical analysis

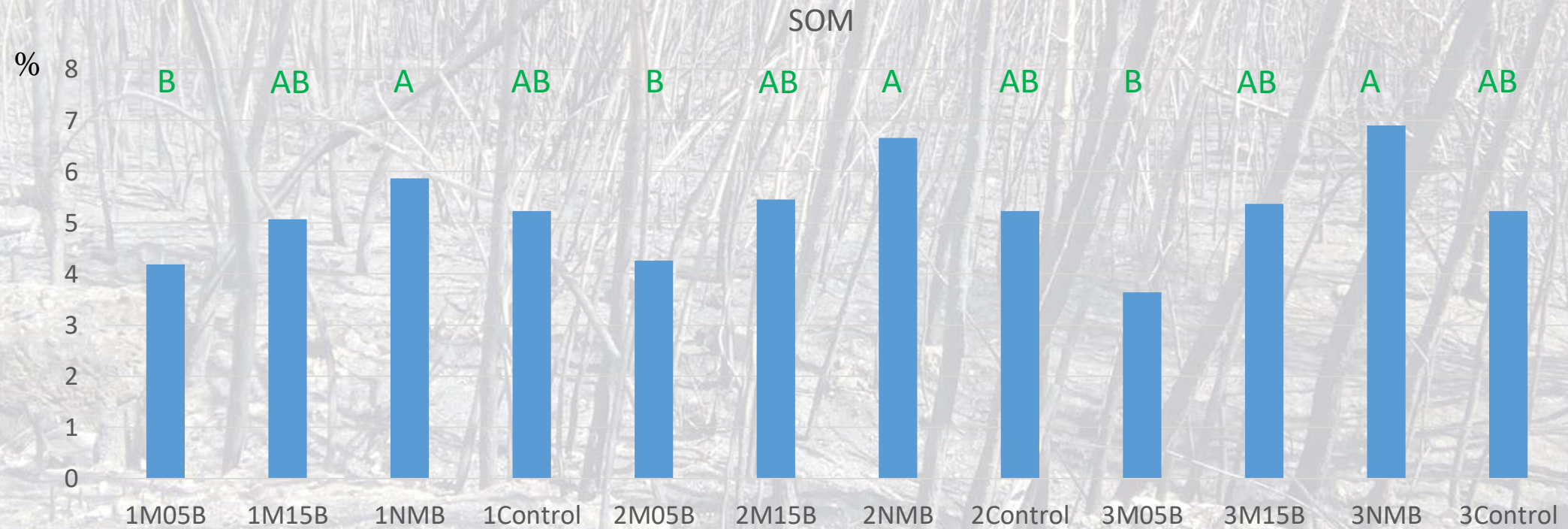
*Soil physical property***Capital letters compare different areas in each sampling****Low case letters compare different samplings in each area**

*Soil chemical property***Capital letters compare different areas in each sampling****Low case letters compare different samplings in each area**

Soil chemical property

Capital letters compare different areas in each sampling

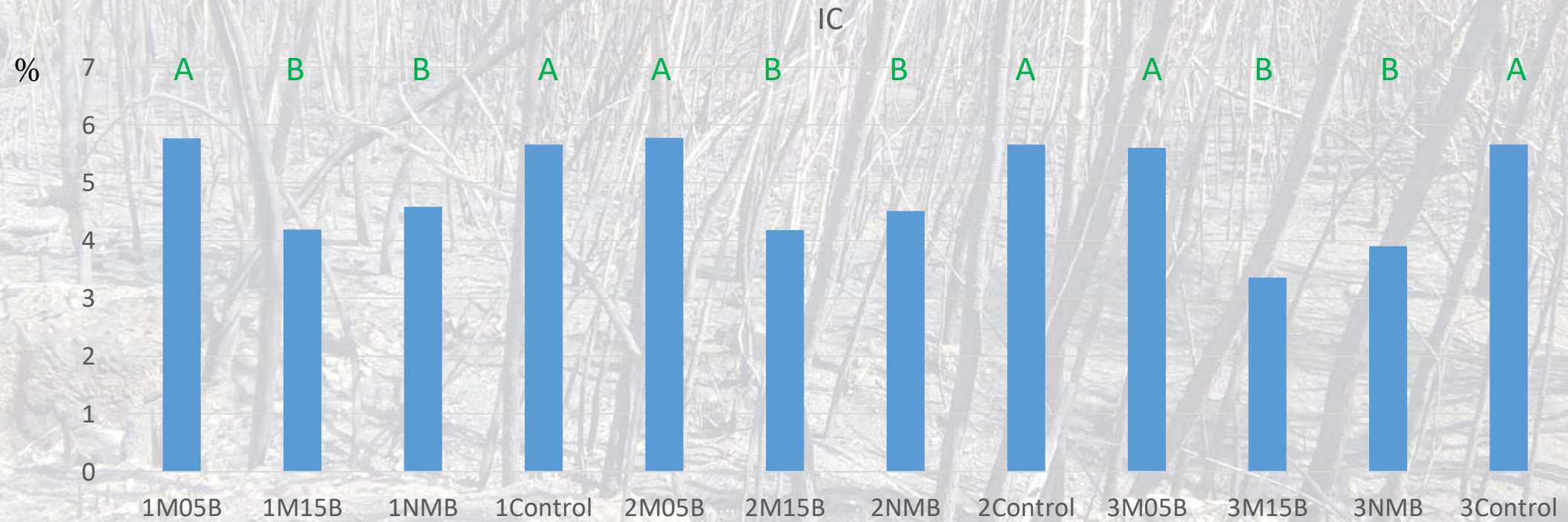
Low case letters compare different samplings in each area

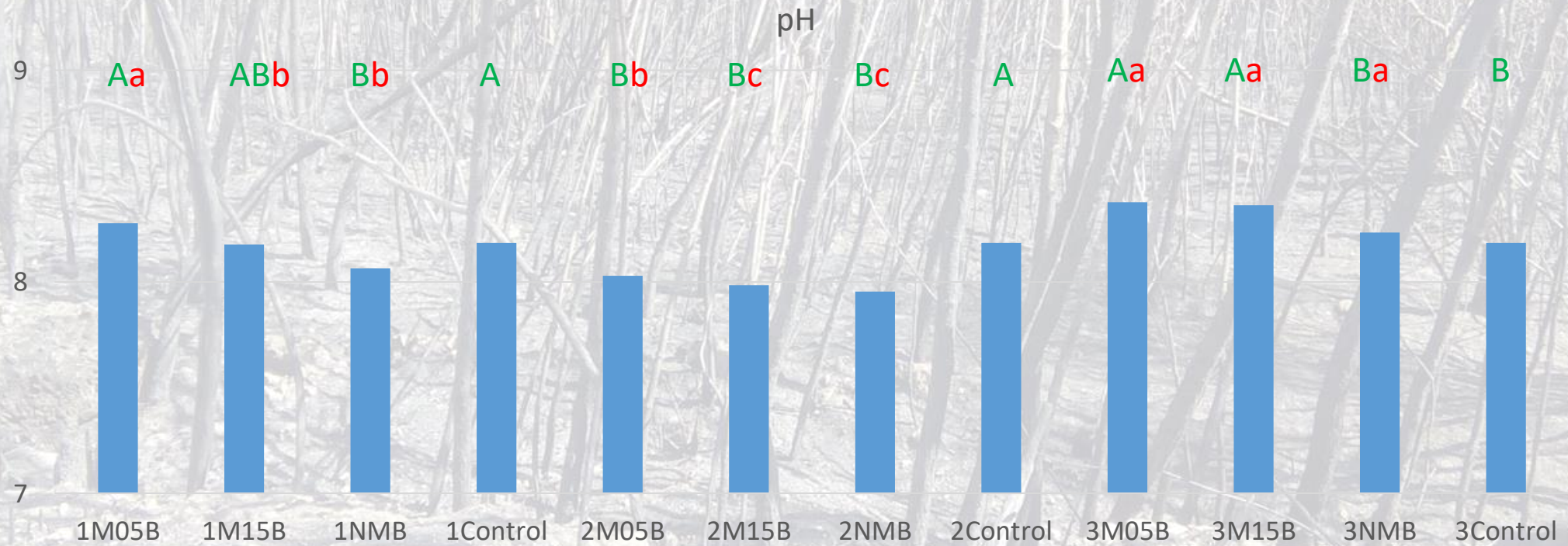


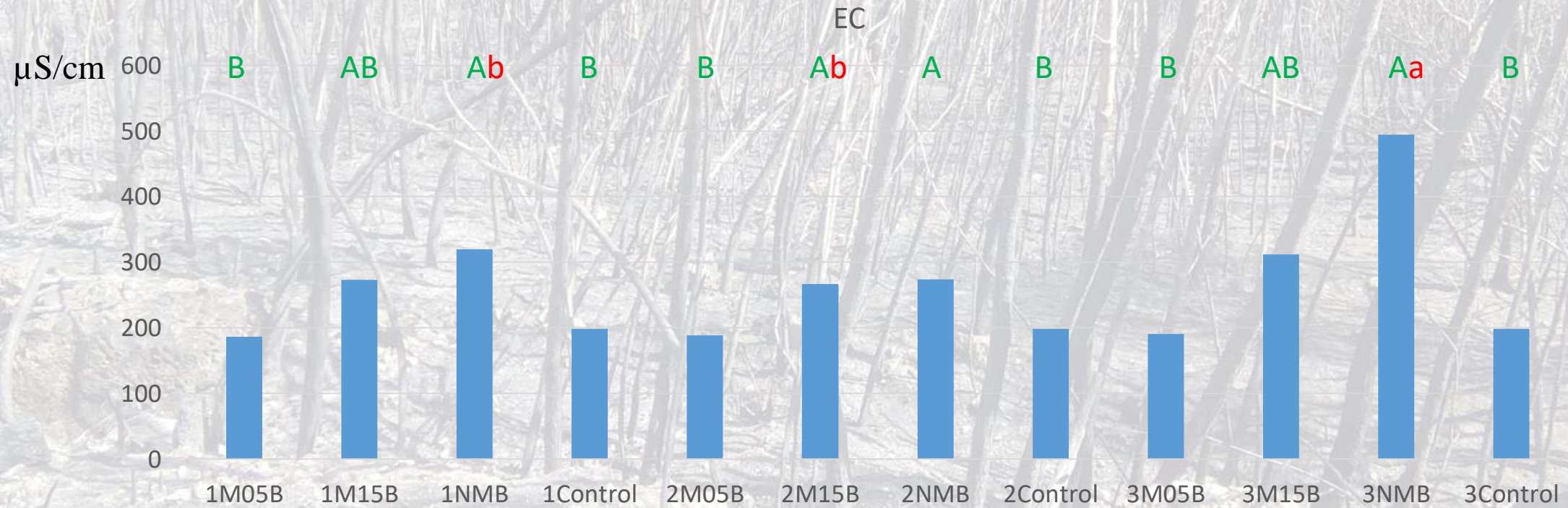
Soil chemical property

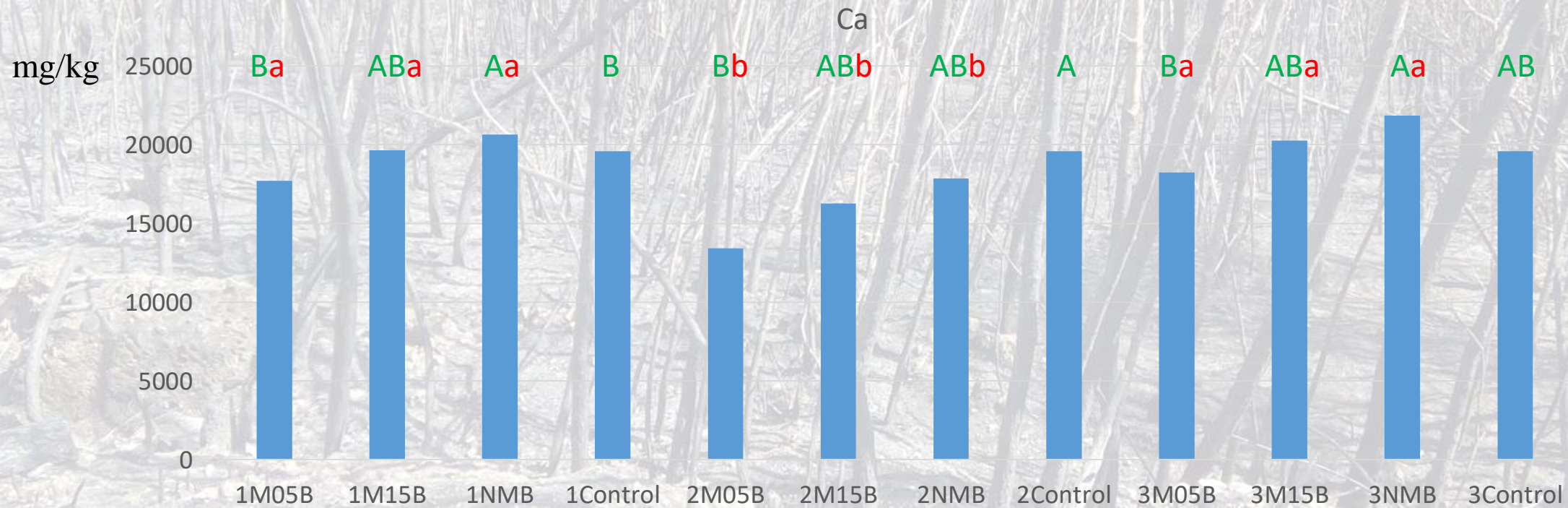
Capital letters compare different areas in each sampling

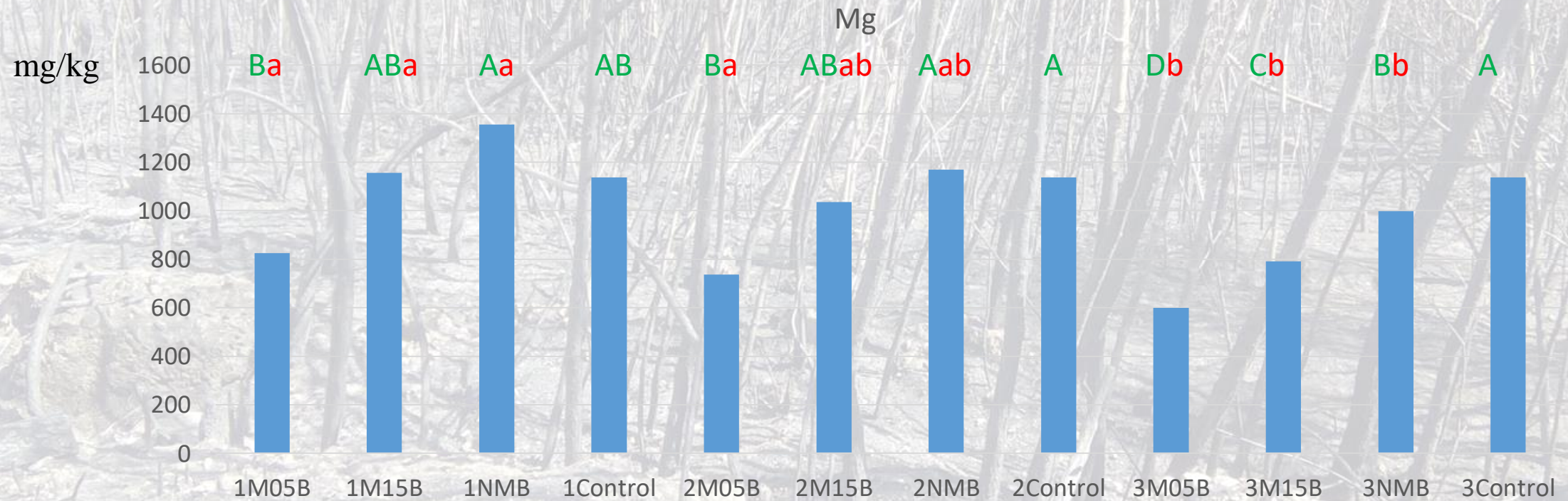
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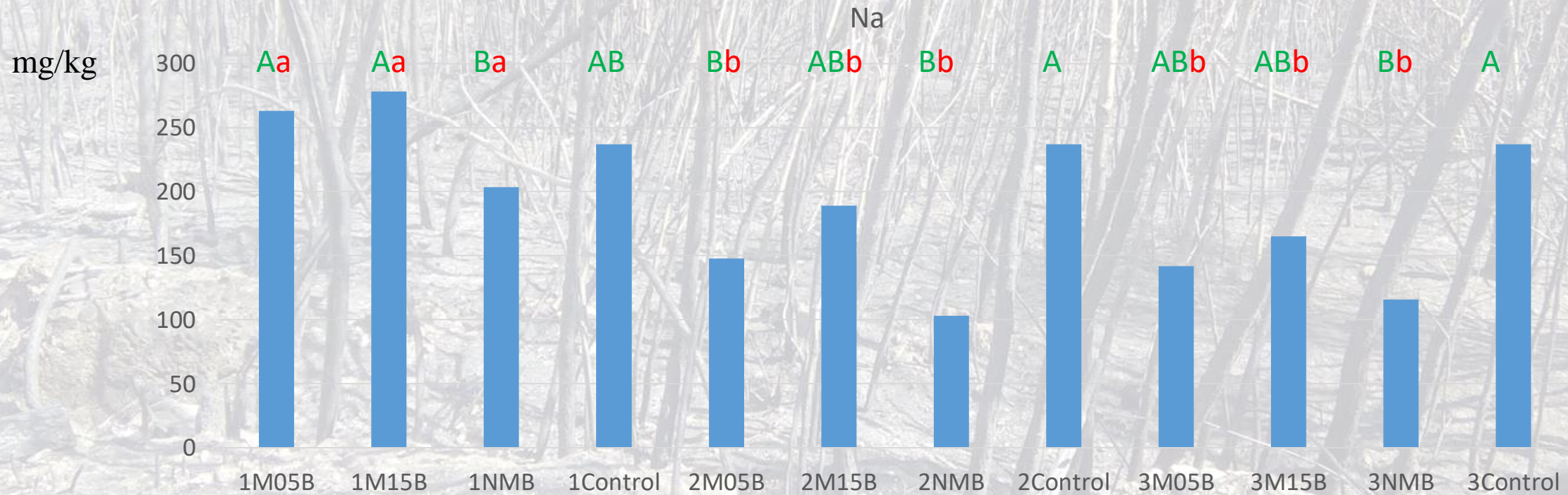


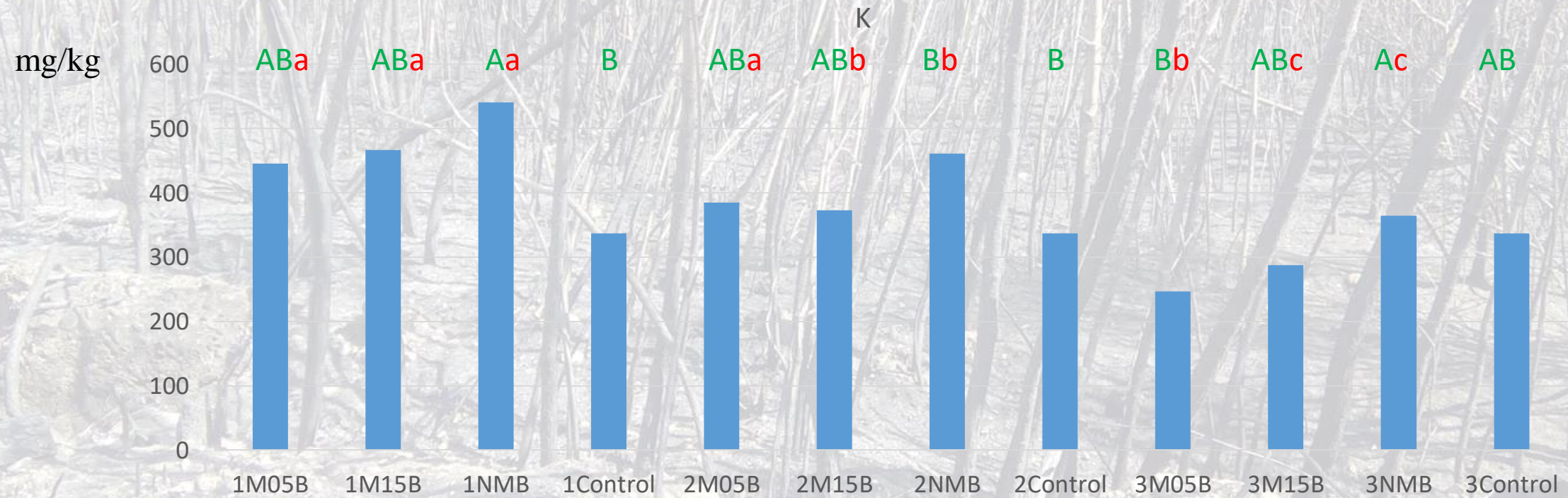
*Soil chemical property***Capital letters compare different areas in each sampling****Low case letters compare different samplings in each area**

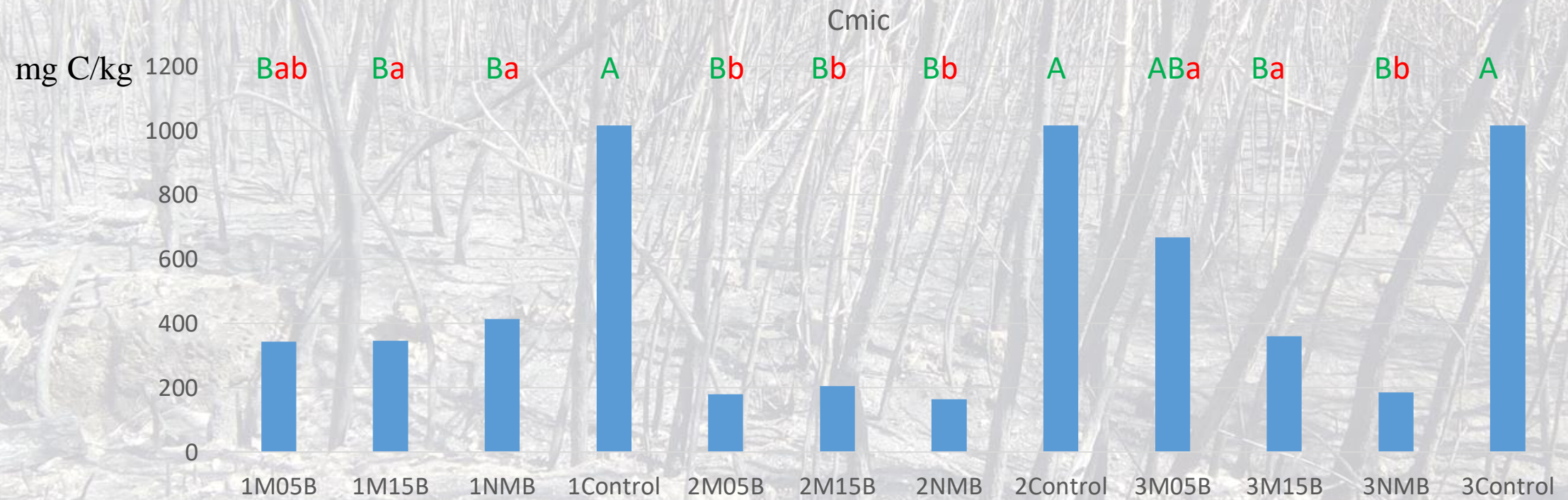
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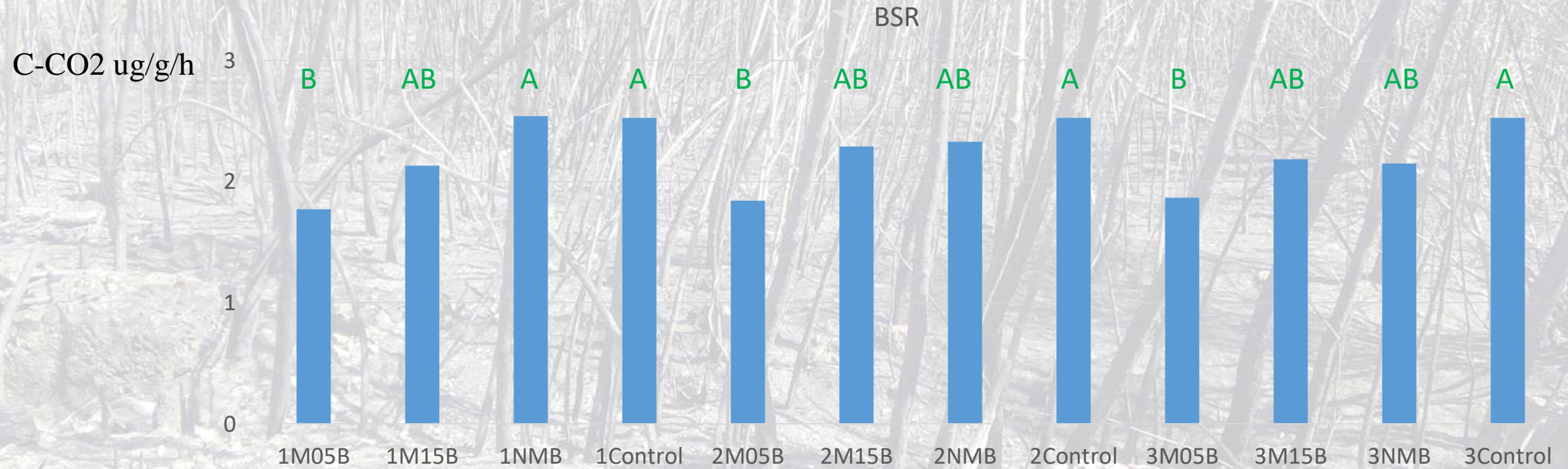
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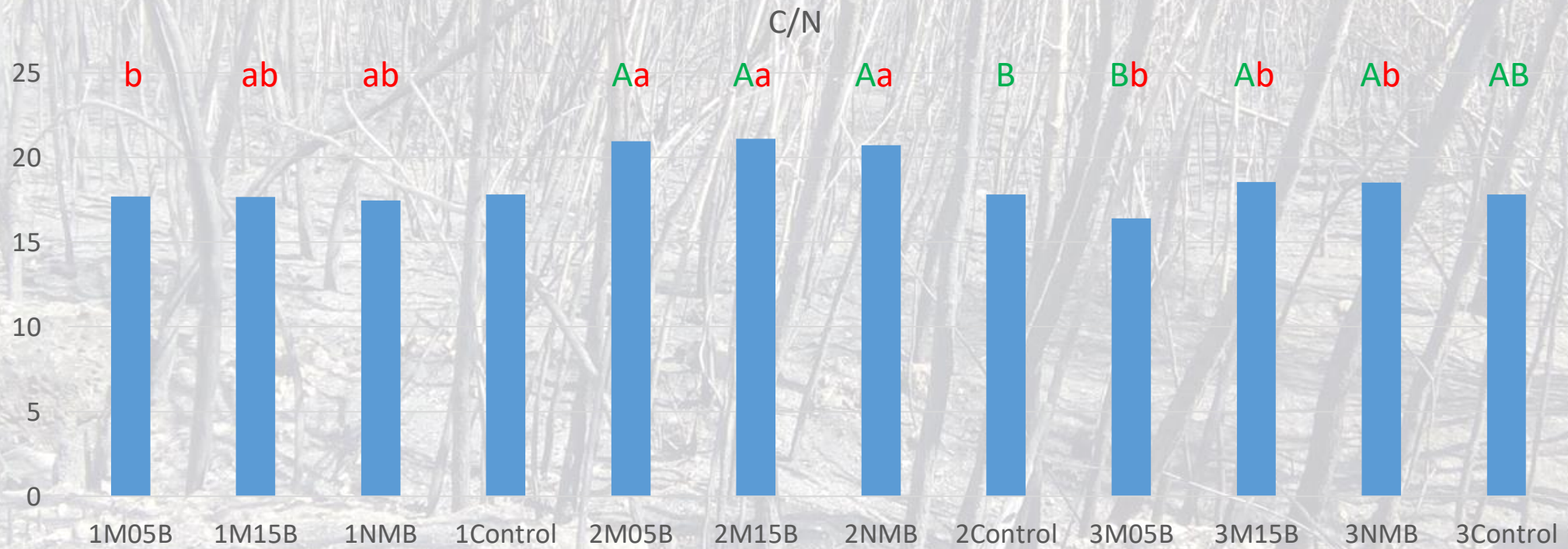
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*Soil biological property***Capital letters compare different areas in each sampling****Low case letters compare different samplings in each area**

*Soil biological property***Capital letters compare different areas in each sampling****Low case letters compare different samplings in each area**

*Soil ratio***Capital letters compare different areas in each sampling****Low case letters compare different samplings in each area**

- ✓ Overall, a comparison of the pre-fire treatments showed that NMB was the practice that had the least negative effects on the soil properties studied, followed by M15B, and that fire severity was highest at M05B due to the accumulation of dead plant fuel
- ✓ Not clearing the cut vegetation from the soil surface affects the severity of the fire and induces more changes in soil properties.
- ✓ However, the differences observed across our study sites were not sufficiently significant to conclude that this is a detrimental treatment.
- ✓ On balance, we recommend this treatment as a way of preventing the outbreak of new forest fires, but large accumulations of cut vegetation covering the soil surface should be avoided so as to reduce fire severity in potential medium- to long-term episodes of wildfire.
- ✓ Clearly, further studies are needed to analyze the effect of clear-cutting management practices on soil properties to ensure the implementation of appropriate forest management and to determine if differences between treated and untreated areas increase or disappear over time.

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