SOIL COMPACTION AND VEGETATION COVER IN A SCOTS PINE STAND AT THE MEDITERRANEAN RANGELANDS

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Introduction

Fig.2: Rimik CP20 Cone Penetrometer

Right development of **ROOT SYSTEMS** is essential to ensure seedling survival in the initial stages of **natural regeneration** processes.

Soil **compaction** determines this development both because of its influence on soil Tª & moisture dynamics and for its direct effect on soil mechanical impedance to root growth.

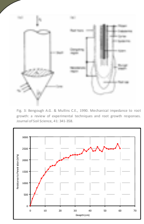
All this effects can be assessed as a whole through **soil penetration resistance** (Soil Strength) measurements.

SOIL STRENGTH has been usually evaluated in forest research in connection with severe disturbances derived from heavy machinery works during forest operations. Nevertheless, **undisturbed soils** are also expected to show different levels of compaction for root development.

Organic matter modifies soil structure and so on porosity, compaction and resultant soil resistance to penetration. Its concentration in surface layers is rather related to vegetation cover composition and density.

So within forest stands, a **relationship** is expected to be found between **VEGETATION COVER** density and compaction measured as **resistance to penetration** (soil strength)

Fig.1: Study Area within Madrid Region



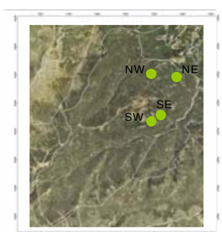
Most **penetrometers** consist of a metal probe with a conical tip fixed onto a cylindrical shaft.. The probe is pushed vertically into the soil at a uniform speed. Pressure and depth are registered and so on penetrometers provide estimations of soil resistance to penetration (kPa) by depth.

Is there any relationship between vegetation cover density and soil compaction measured as resistance to penetration?

Methodology

SITE DESCRIPTION

Private State "Monte Cabeza de Hierro" (Rascafría. Madrid, España). Total area of 2.016 ha with over 1850 ha settled by a Scots pine (*Pinus sylvestris*) stand in uneven-aged structure in most of the management units. Under the main stratum (pinewood), specially in the lowest parts of the hills, a layer of oak (*Quercus pyrenaica*) is common and abundant. Frequent shrubland presence in gaps (*Genista* spp.; *Cytisus* spp.; *Pteridium aquilinum*…). First Forest Management Plan in 1957, nowadays planning based on floating periodic block method and shelterwood regeneration system.



SAMPLING

Four sampling Areas (NE, NW, SE, SW). **192 sampling point** (48 x Area)

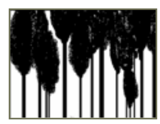
	Sampling Areas			
	SW	SE	NW	NE
Mean Slope (%)	15,6	18,6	8,8	9,9
Mean Heigth (m)	1526,7	1517,4	1441,4	1338,6
Mean Aspect (ºC)	174,8	142,2	268,3	76,4

Measurements (xPoint)

RP
Soil Resistance to Penetration (kPa) [Rimik CP20 Cone Penet.]

% H
Soil Moisture [TDR sensor]

G: Basal Area (m2/ha) in Ǿ=30m
% GAP Fraction [Fisheye]



% Grass Cover
%Shrub Cover
%Debris Cover
Thickness of [O+A] horizons (cm)

Results

- **SOIL STRENGTH VALUES increase significantly** with **depth** between 0 and 20 cm.
- **STAND DENSITY INDEX** (both Basal Area and GAP Fraction) show **significant linear correlation** with **Soil Resistance to Penetration** (RP)
- Regarding small size cover, only **%GRASS COVER** and **THICKNESS OF [O+A] HORIZONS** seems to **significantly correlate** to **RP**
- Pearson Correlation Coefficient absolute **values tend to be low** due to the multifactoriality of the studied process.
- In general, observed tendencies show inverse correlation between vegetation density and RP:

DENSER VEGETATION COVER ⇒ LOWER SOIL STRENGTH

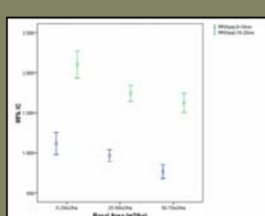
	Mean	Std.Error	Min	Max
$RP_{(0\text{-}10cm)}$	937,9	26,0	183,6	1676,1
$RP_{(10\text{-}20cm)}$	1.755,6	36,9	472,2	2833,3
Moisture (%)	12,2	0,5	1,0	25,5

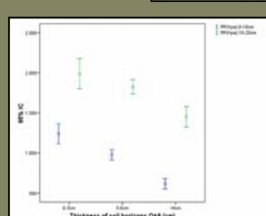
φ	$RP_{0\text{-}10cm}$	$RP_{10\text{-}20cm}$
Basal Area (m2/ha)	-0,42**	-0,33**
1-GAP Fraction	-0,40**	-0,35**
Grass Cover (%)	0,50**	0,36**
Shrub Cover (%)	-0,19**	-0,06
Debris Cover (%)	-0,36**	-0,26**
O+A Horizons (cm)	-0,62**	-0,45**

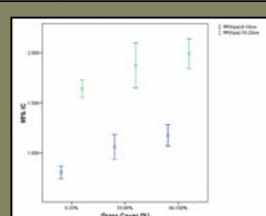
- Only %Grass cover shows the opposite tendence:

HIGHER %GRASS COVER ⇒ HIGHER SOIL STRENGTH

This is probably due to the effect of the peculiarities of the radical systems of this plant formation.







Conclusions

Vegetation cover density significantly affects soil compaction measured as resistance to penetration (soil strength)