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jou kennisvennoot • your knowledge partner

The combined effect of slash burning and repeated disc harrowing on changes in fuel loading, soil properties, root growth and stand productivity of Eucalypts in Mpumalanga: South Africa

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mondi

DISC HARROWING

Agri expo (2019)

INTRODUCTION

- In SA about 1 143 116 ha has some form of damage: fire 669 439 ha (59%) and 473 677 ha (41%) other abiotic and biotic factors
- Unmanaged fuels contribute significantly to occurrence, spread, and intense damage caused by wildfires
- Disc harrowing breaks fuel horizontal continuity = reduce surface fire rate of spread and reduce fuel loading = less fire intensity
- **Problem:** There is not enough evidence to quantify the effects and support the effectiveness of this practice

STUDY OBJECTIVES

- Effectiveness of disc harrowing throughout stand rotation on fuel load reduction for wildfire management.
- Investigate effect of harvest slash burning incorporated with repeated disc harrowing on soil bulk density & available nutrient pools.
- Determine potential impact of slash burning incorporated with disc harrowing throughout the rotation on *Eucalyptus grandis x nitens* growth.
- Investigate if prescribed burning incorporated with disc ploughing has any effect on root distribution patterns of *Eucalyptus grandis x nitens*.

L. REVIEW: PROS AND CONS TO BURNING OR RETENTION OF HARVEST RESIDUES

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- Fires & harvest residue management impact sites' long-term productivity (du Toit and Scholes, 2002)

- Bark, branches and foliage constitute roughly 68% (N) , 54% (P), 70%(K), 80%(Ca) and 82%(Mg) of aboveground nutrient pools (du Toit, 2003)

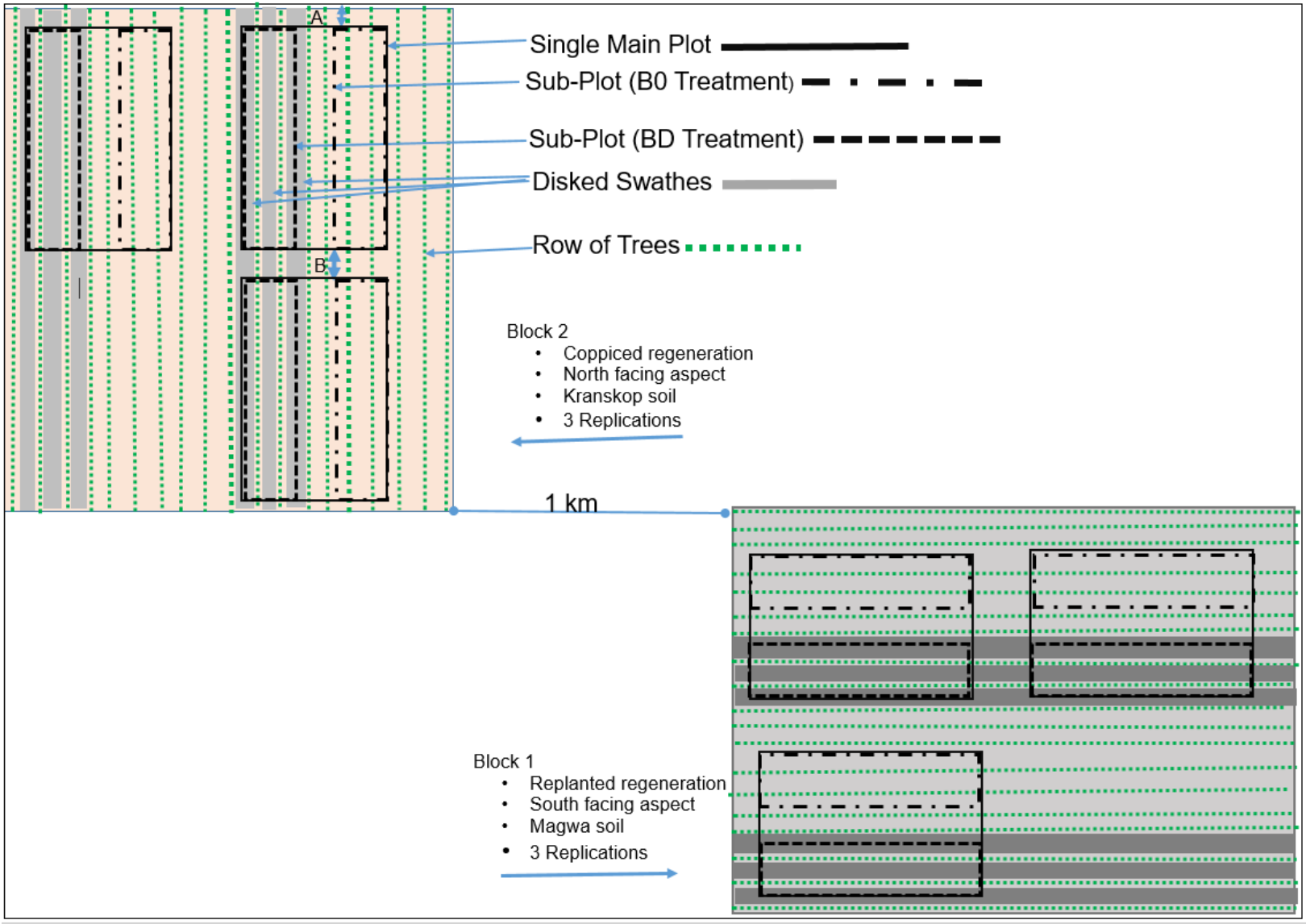
  - Litter fall is a major pathways for nutrient return to soil (Fisher and Binkley, 2000)

- However, slash retention limits site access for planting, growth suppression, and fire hazard

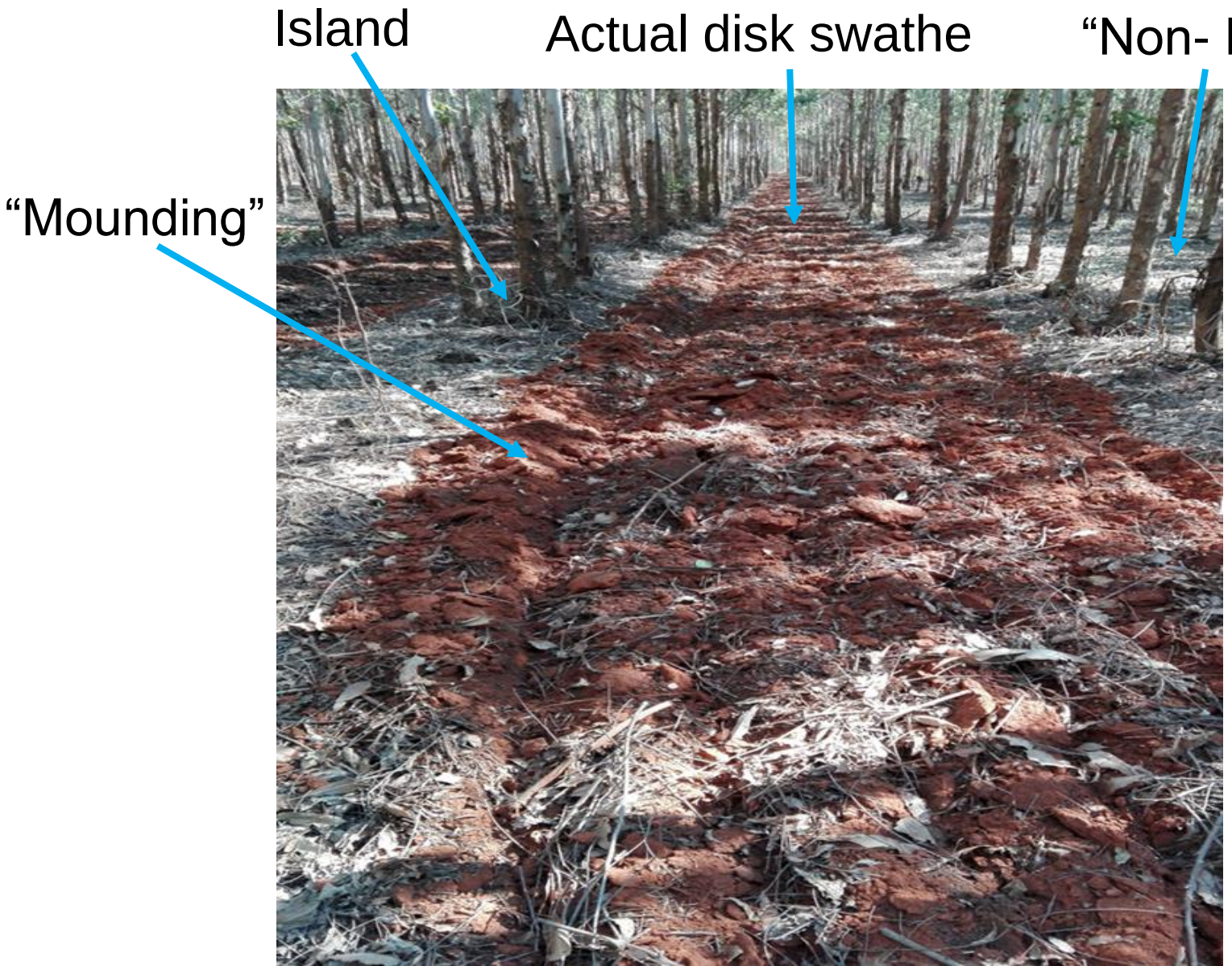
- Slash burn reduce fire hazard, allelopathy (Águas et al, 2017)

- Ash bed effect (pH & P availability), low to medium intensity

METHODOLOGY: Study Design

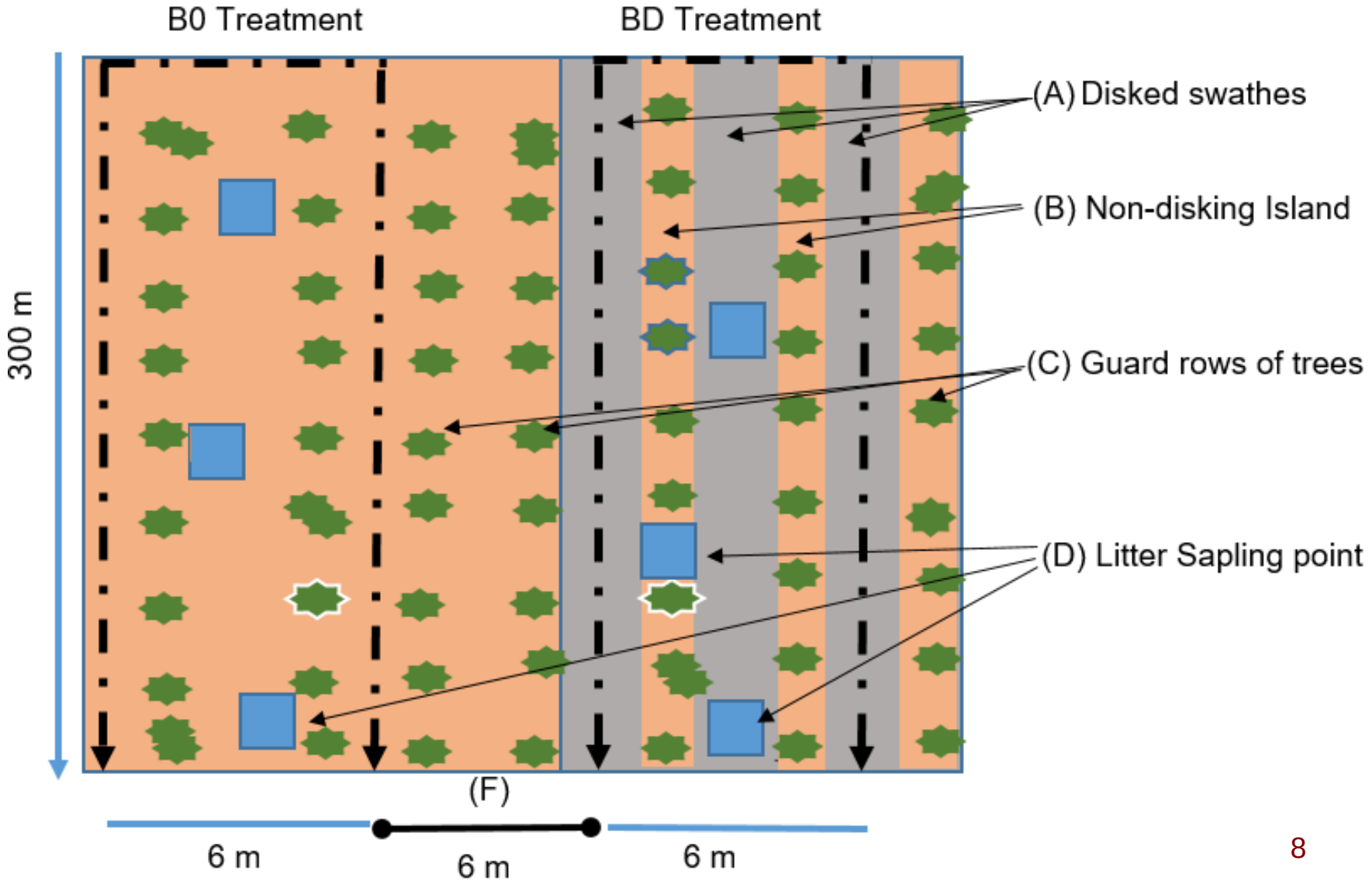


METHODOLOGY: Study Design



METHODOLOGY: Data Collection

Litter Sampling



METHODOLOGY: Data Collection

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Step 1

Step 2

Step 3

Step 4

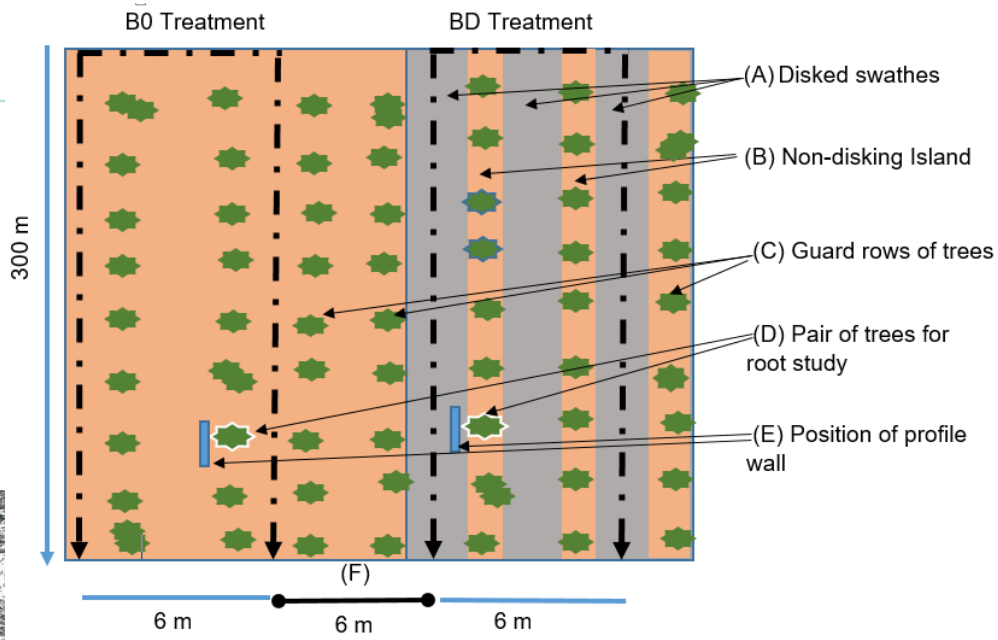
METHODOLOGY: Data Collection

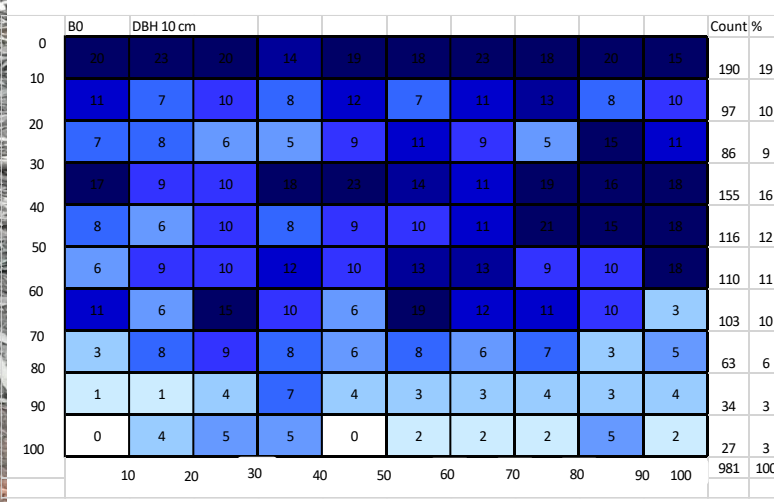
The Above Ground Tree Growth

- Tree DBH and heights
- Tree growth variables:
  - Individual tree
    - Density stems/ha
  - Stand level
    - Volume $m^3\ ha^{-1}$,
    - Basal Area $m^2\ ha^{-1}$, and
    - Above-ground Biomass $t\ ha^{-1}$

METHODOLOGY: Data Collection

Root distribution Patterns

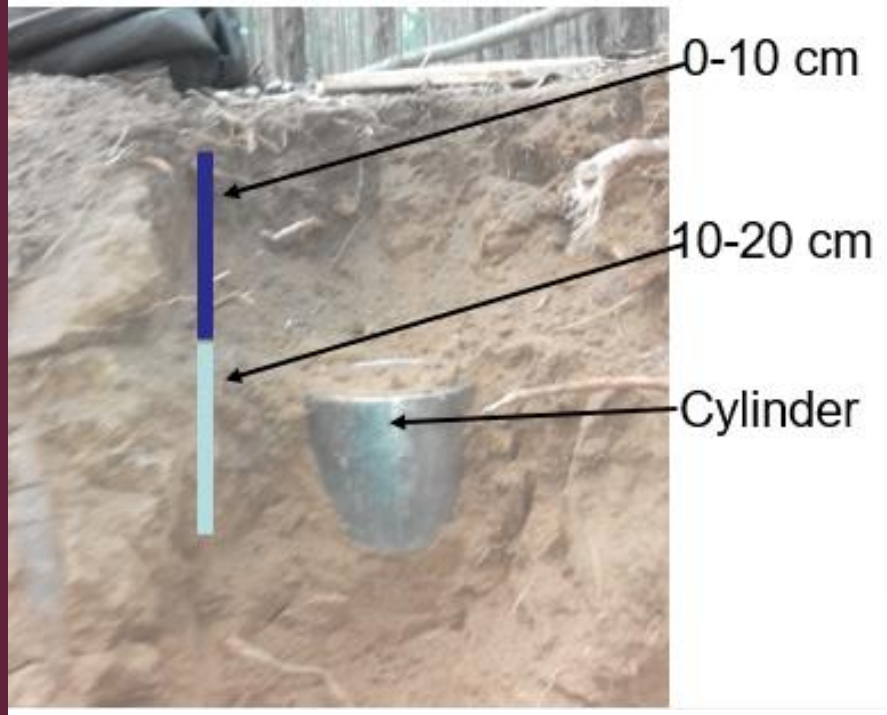




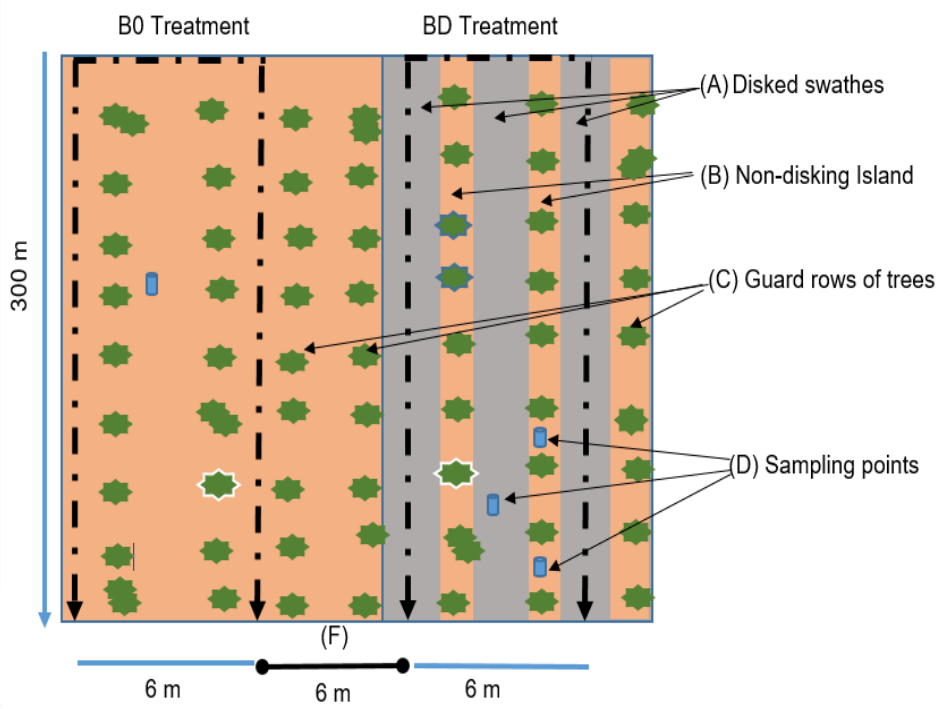
Profile wall root study method (Böhm W, 1979)

METHODOLOGY: Data Collection

Soil Sampling

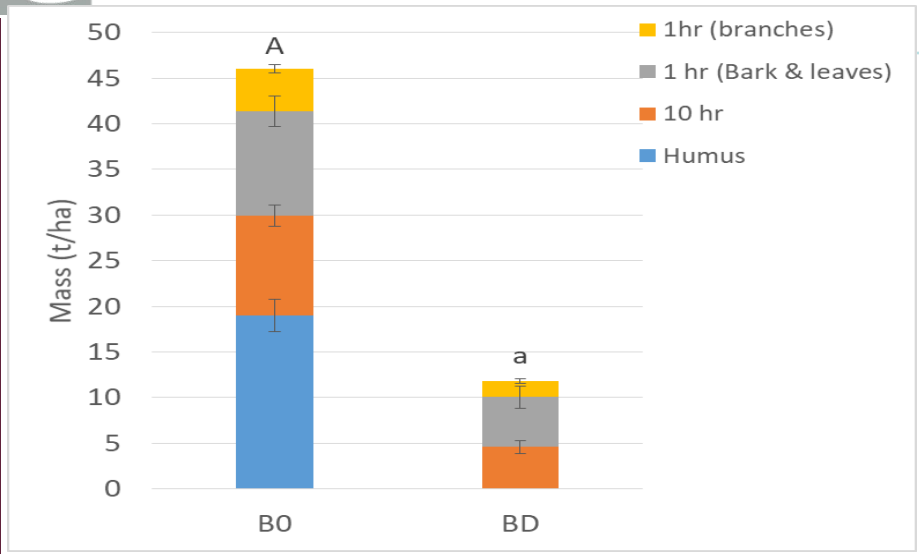


Bulk density

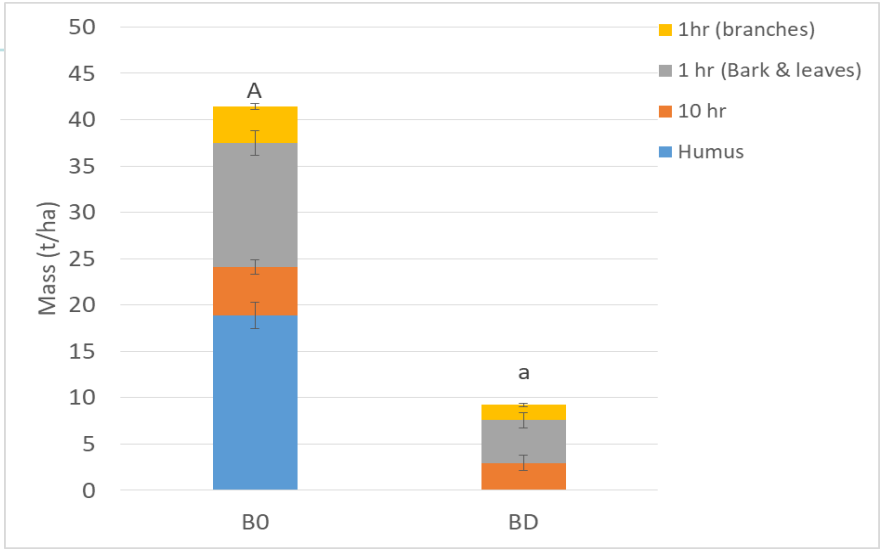


Chemical analysis

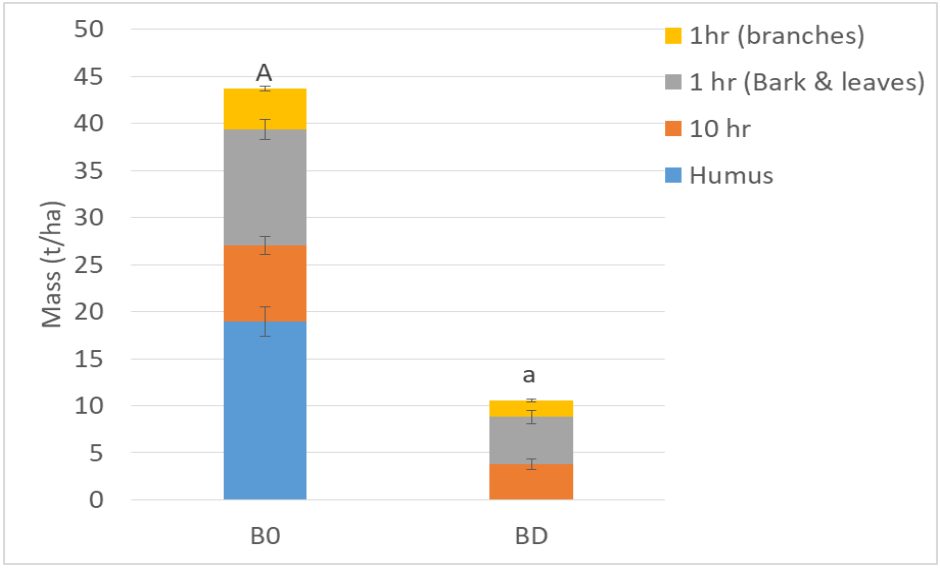
Results: Litter & Fuel Loading



Block 1: All sig at $p<0.05$

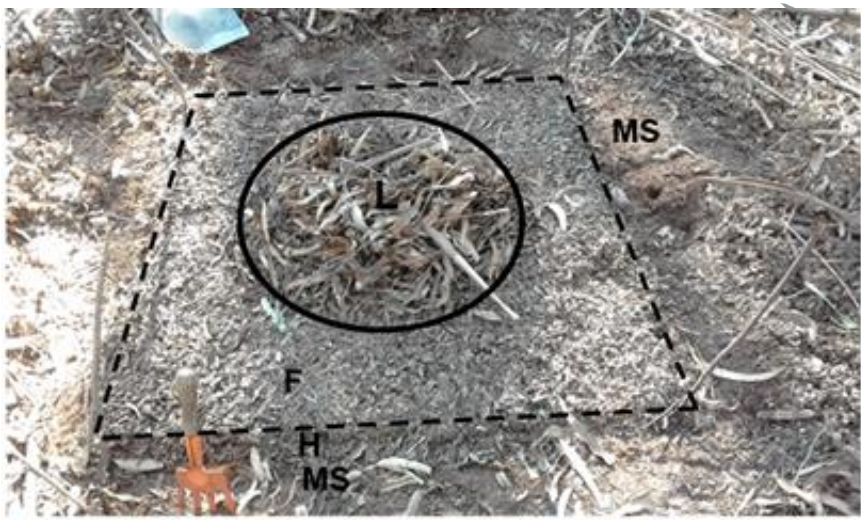


Block 2: All sig at $p<0.05$

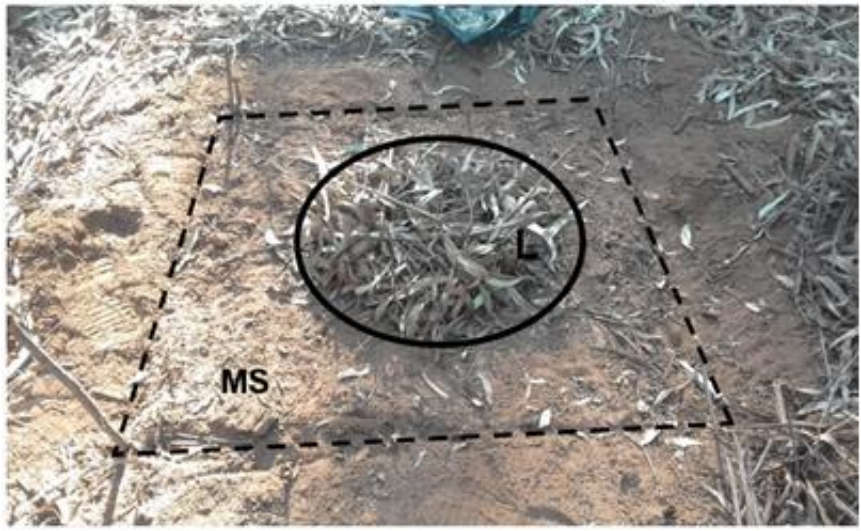


Blocks combined: All sig at $p<0.05$

Results: Forest Floor Structure

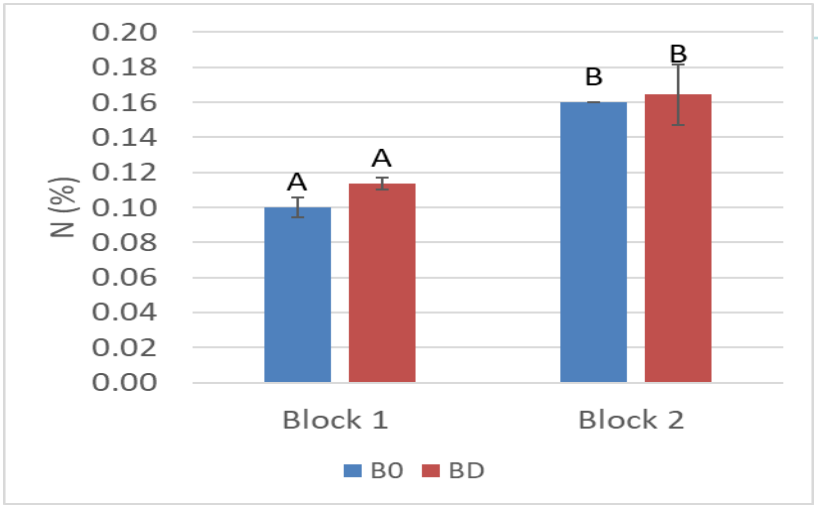


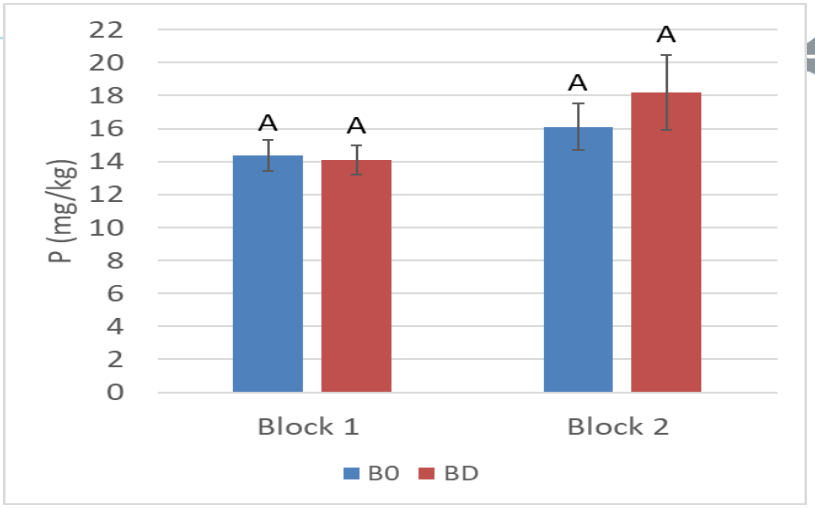
Non-disc harrowed forest floor



Repeatedly disc harrowed forest floor

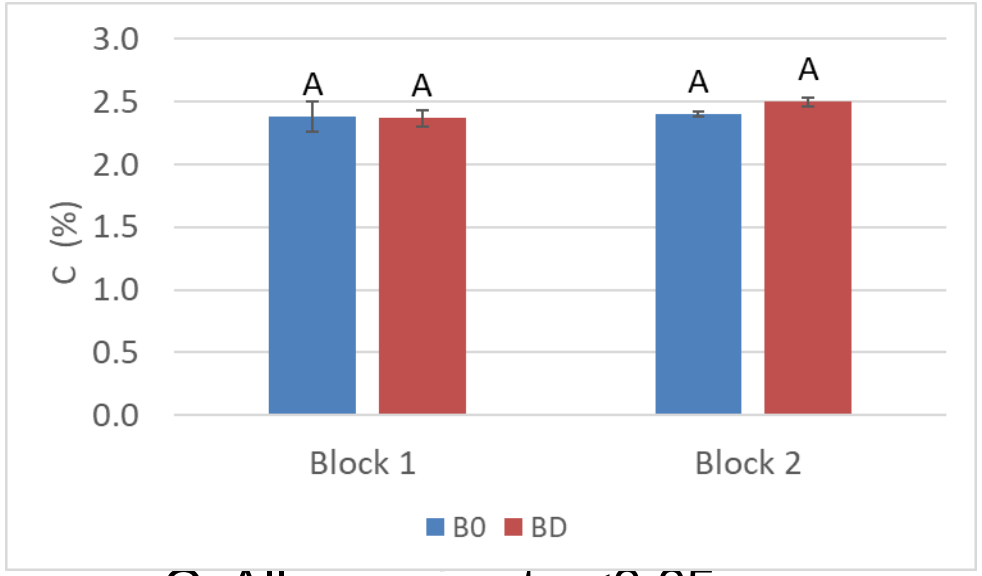
Results: Total N, Bray 2 P, & Organic C





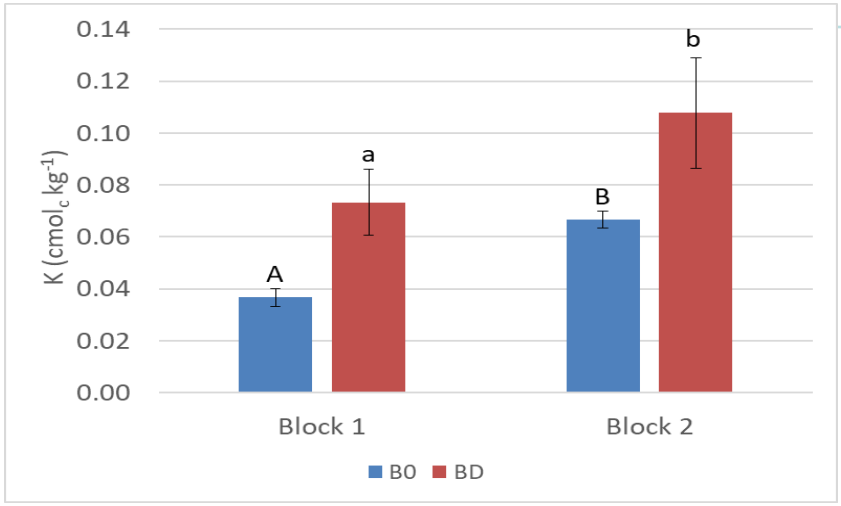
N: sig at $p<0.05$ between blocks

P: All non-sig at $p<0.05$

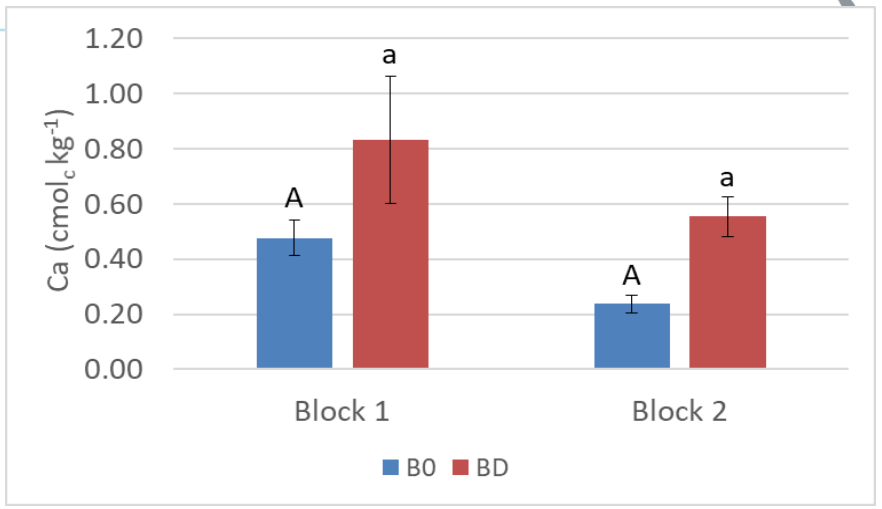


C: All non-sig at $p<0.05$

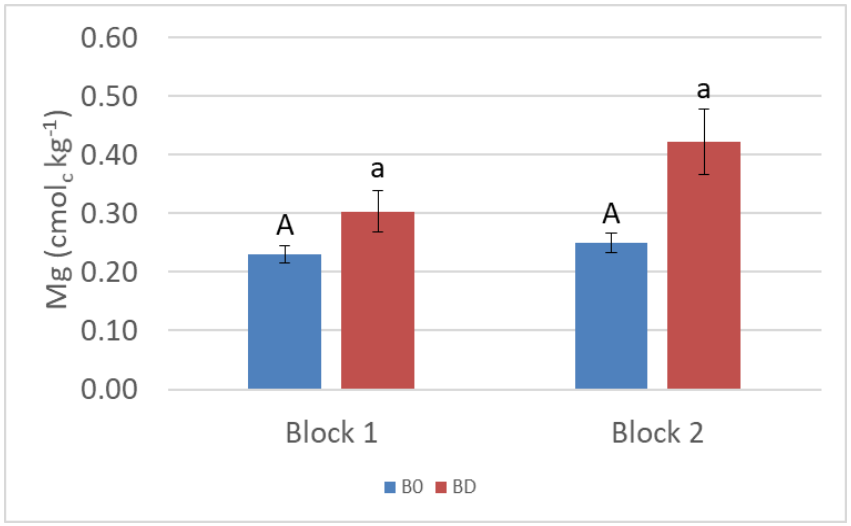
Results: Exchangeable Base Cations



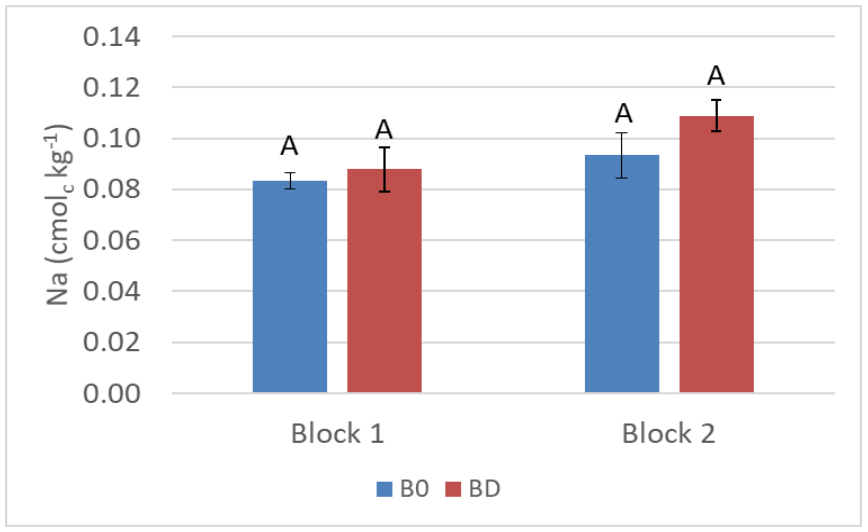
K: sig at $p<0.05$ between blocks & treatment



Ca: sig at $p<0.05$ between blocks & treatment



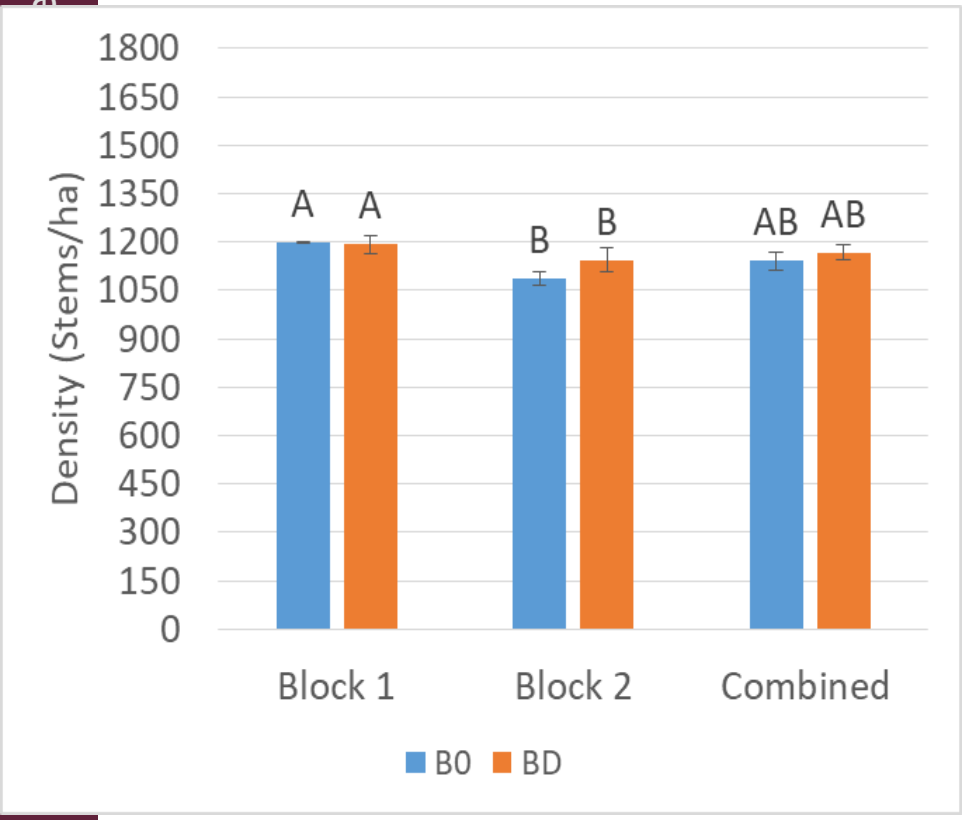
Mg: sig at $p<0.05$ between blocks & treatment



Na: All non-sig at $p<0.05$

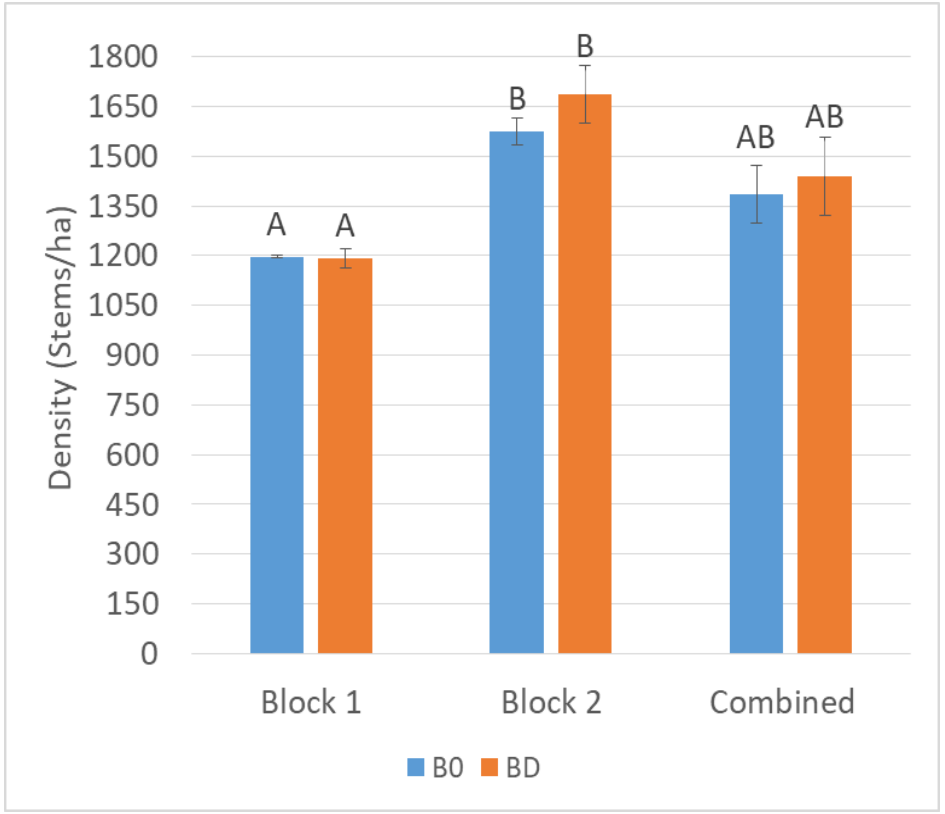
Results: Stand Density

Density (stump)



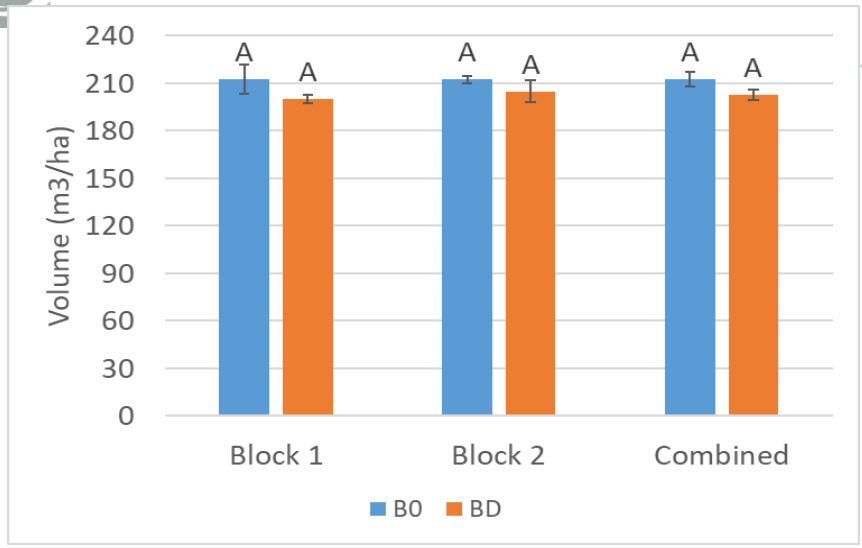
Sig at $p<0.05$ between blocks

Density (stem)

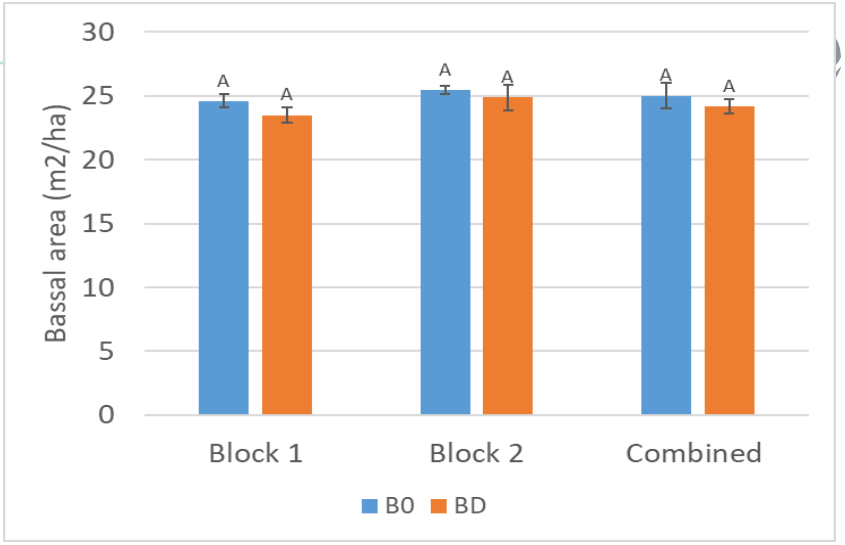


Sig at $p<0.05$ between blocks

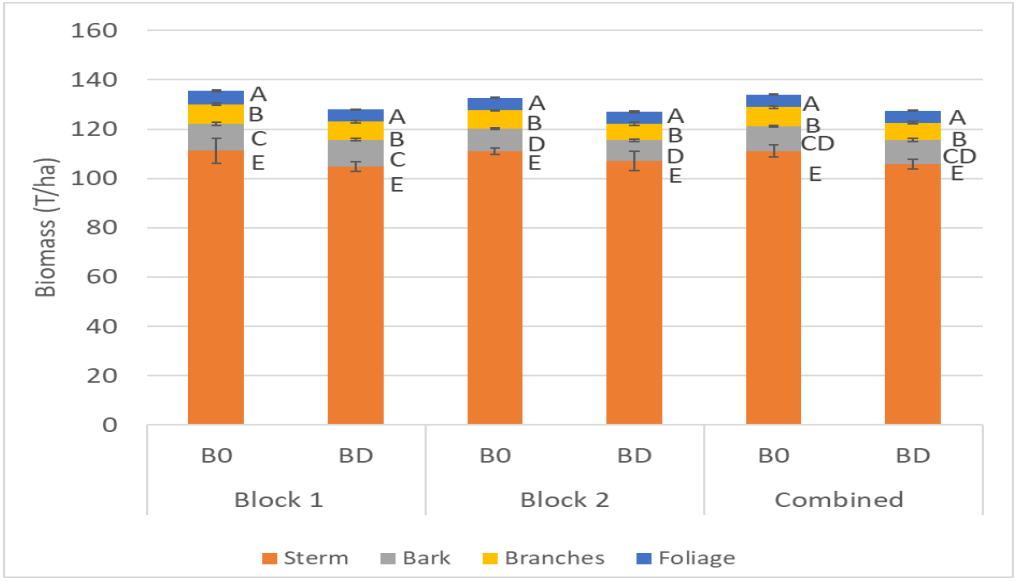
Results: Stand Volume & Biomass



Stand volume: All non-sig at $p<0.05$

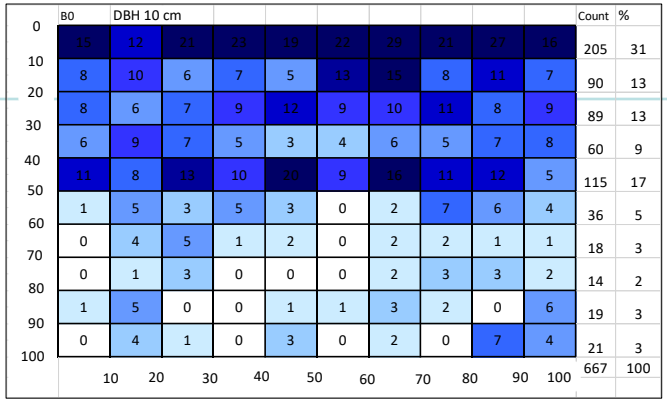


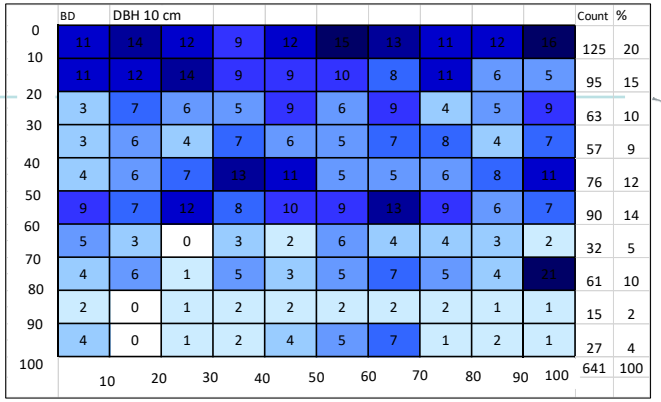
Stand basal area: All non-sig at $p<0.05$

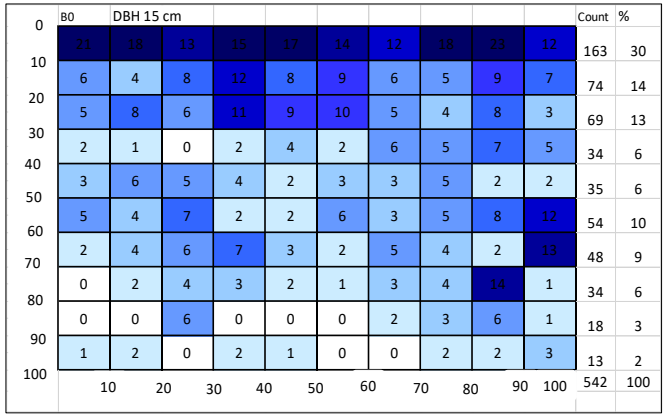


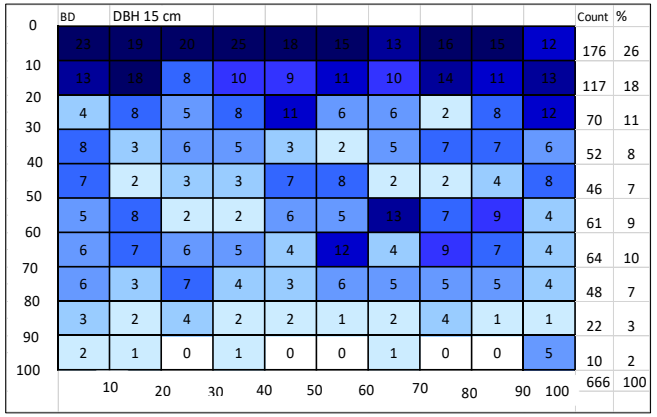
Biomass: All non-sig at $p<0.05$ (except bark: blocks)

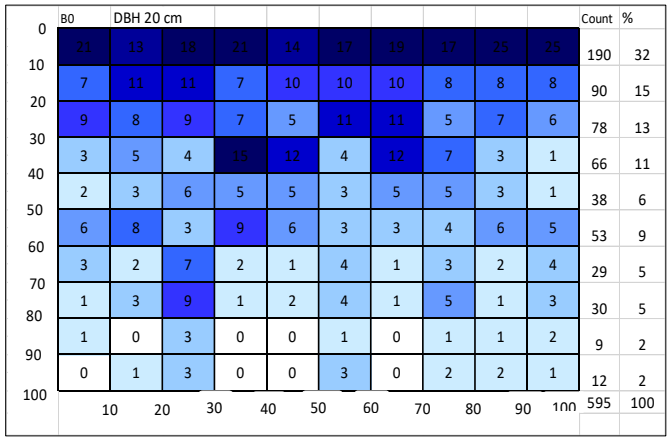
Results: Root Distribution Patterns (Block 1)

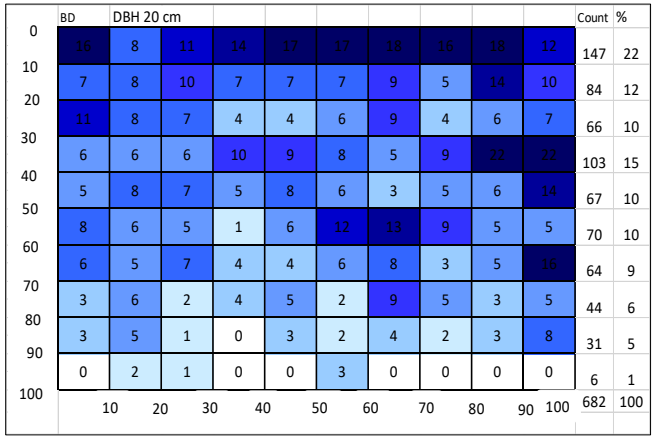












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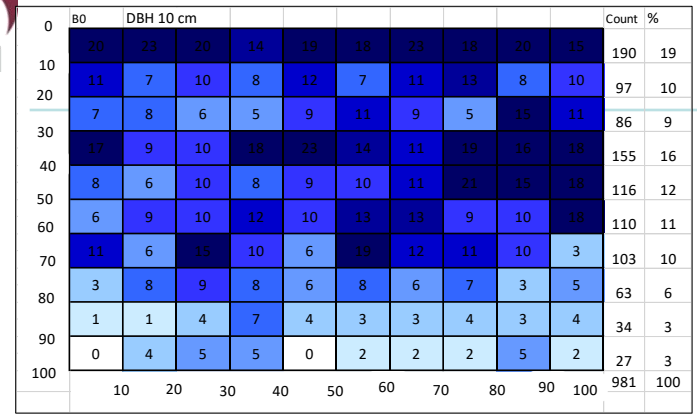
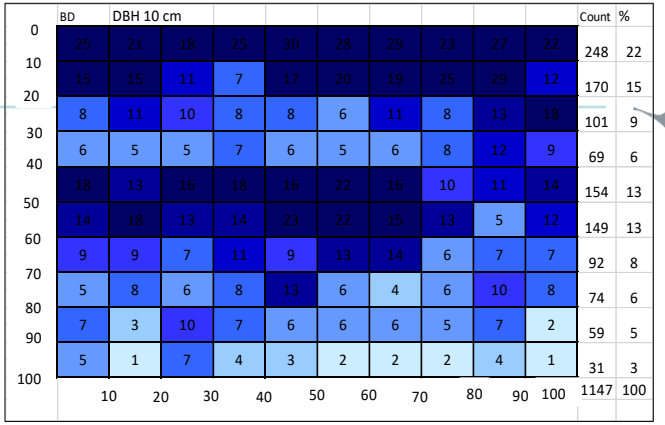
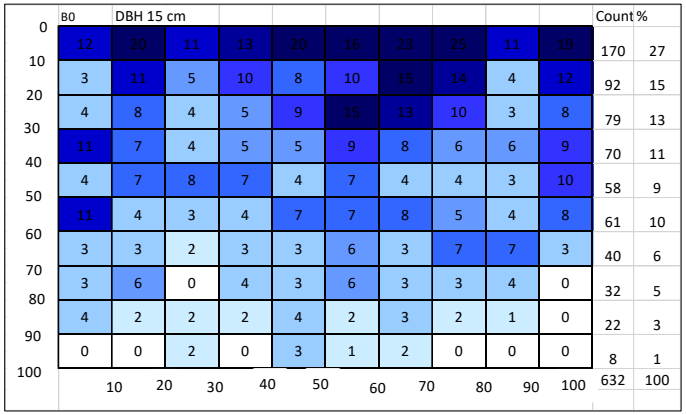
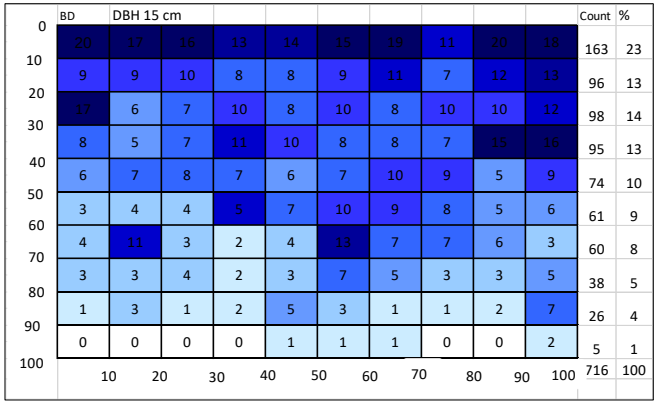
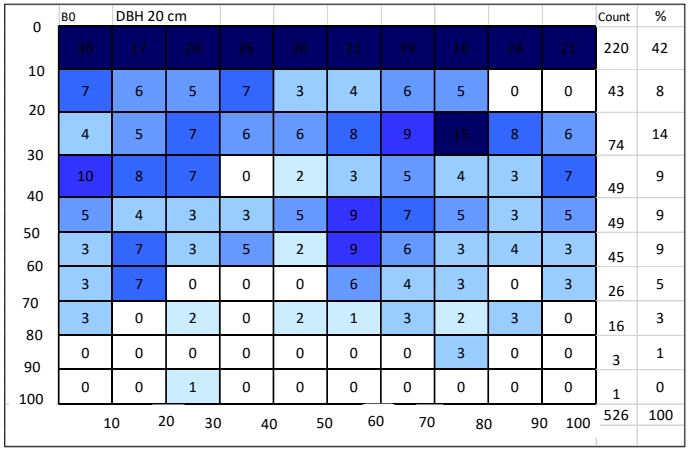
Results: Root Distribution Patterns (Block 2)

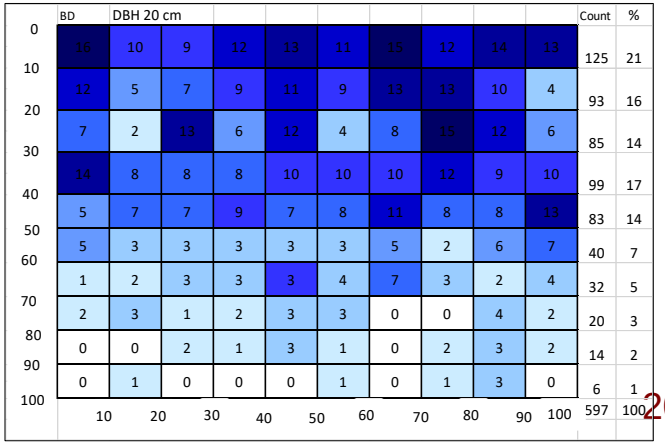












CONCLUSION

- Repeated harrowing incorporated organic material into soil and effectively reduces fuel loading.
- No effect on NPC, but improved exchangeable cations, as well as reduced soil bulk density.
- Change of root distribution & reduction on tree growth and stand productivity, but not significant.
- Benefit of fire risk reduction off set for the negative implication on the negligible reduction in tree growth and stand productivity.

Thank You!

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METHODOLOGY: Lab Work

- Bulk density: Oven dry mass divided by volume of the cylinder
- Total N = Kjedahl technique (Buurman, Lagen and Velthorst, 1996)
- Available P = Bray II solution as an extractant (Hunter, 1974)
- Organic C fraction measured using potassium permanganate as an oxidising agent following Blair et al. (1995) procedure
- Exchangeable cations (AMBIC), pH (in KCL)

LITERATURE REVIEW: BIO CHARCOAL ON SOIL PROPERTIES & SITE PRODUCTIVITY

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- Bio charcoal influence soil physical and chemical properties: site-specific (Kolb, Fermanich & Dornbush 2009).
- Biomass material: animal waste, municipal waste, and agriculture & wood residues (straws, thinning, and harvest residues) (Wróbel-Tobiszewska 2014).
- Bio charcoal characteristics determined by : temperature, residence time, & available oxygen during pyrolysis.
- Good qualities: prolonged chemically active time in soil, physical form (micro pores and a relatively large surface area), and negatively charged surface area (adsorption) (Carter et al 2018).

METHODOLOGY: Sorting, Followed by Milling and Analysis

Fuel Classes

METHODOLOGY: Data Analysis

- The following procedure was followed in SAS:
- One-Way ANOVA to test for homogeneity: Levene's and Bartlett's $p<0.05$
  - If not then transform
- ANOVA linear model (nested design) at $p<0.05$
  - Bonnferoni (Dunn) t-Test will be used to follow up where significant difference
- Normality (residuals): Shapio-Wilk test $p<0.05$.

More Details

- Thesis like below
- https://scholar.sun.ac.za/items/945e93f2-abdb-4ac3-b84b-b4ffdc87fe2b

- Forsilvitech link below
- https://www.forsilvitech.com/article/disc-harrowing-for-fuel-load-management-in-eucalyptus-stands/#:~:text=Repeated%20disc%20harrowing%20significantly%20increased,1%20respectively%20following%20repeated%20disking.