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Influence of Acacia trees on soil nutrient levels in arid lands

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INTRODUCTION AND OBJECTIVES

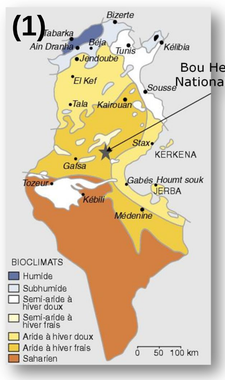
- Important role of **scattered trees** in arid regions → strong influence on the abiotic environment below-canopy
- Function as 'nurse plants' or '**fertility islands**' → facilitate the recruitment of other plants (e.g. herbaceous ground cover)
- ***Acacia*** *tortilis* (Forssk.) Hayne subsp. *Raddiana* (Savi) Brenan as **keystone species**

- Investigate the impact of *A. raddiana* trees on **soil nutrient levels**:
  - along gradient form underneath to outside the canopy for upper soil layer (0-10 cm)
  - underneath and outside the canopy for 0-30 cm soil layer

MATERIALS AND METHODS

- **BOU HEDMA NATIONAL PARK (1)**
  - central Tunisia
  - integral protected area of 5.115 ha **(2)**
  - forest-steppe ecosystem
  - arid with moderate winter
  - since 1950s: several reforestation campaigns

(1)



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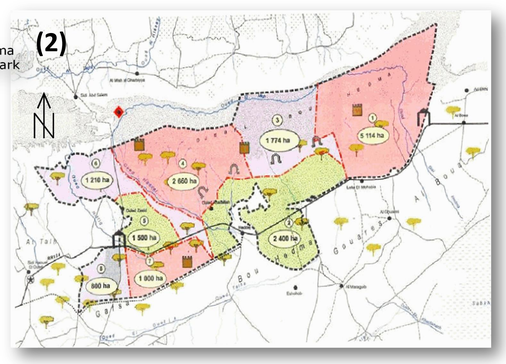
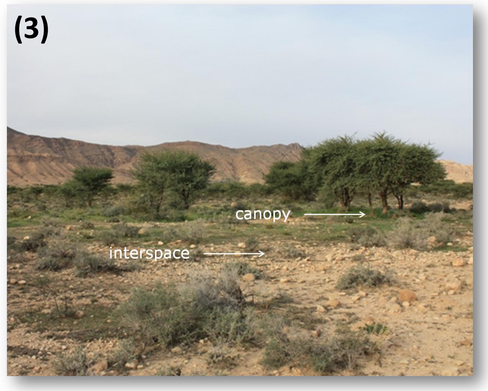


- **TWO HABITATS**: canopy and interspace **(3)**
  - canopy : along a gradient at 25 %, 75 %, 125 % and 175 % of canopy radius in northern direction (microsites M1, M2, M3 and M4) **(4)**
  - interspace: 10 m away from stem, no influence of canopy (microsite M5)

(3)



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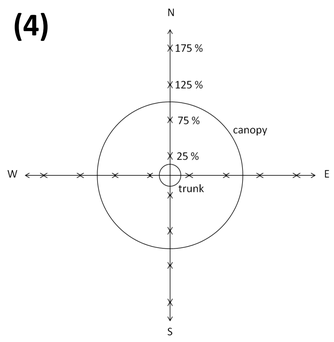
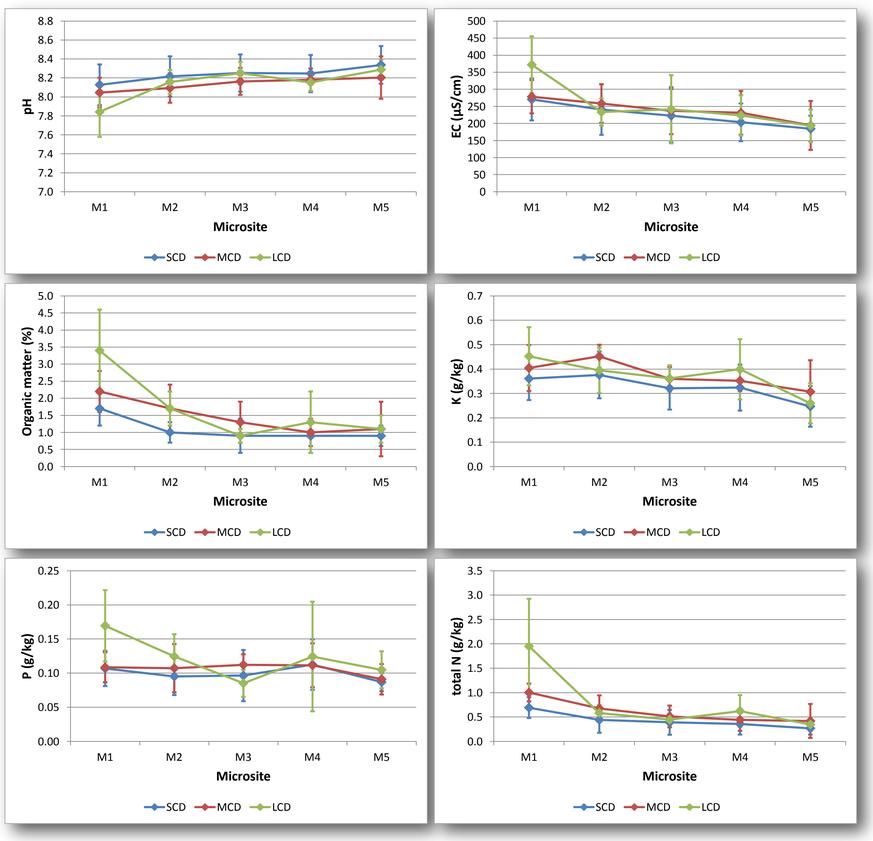


- **THREE CANOPY SIZE GROUPS**
  - small crown diameter (SCD): 3-5 m
  - medium crown diameter (MCD): 5-7 m
  - large crown diameter (LCD): >7 m

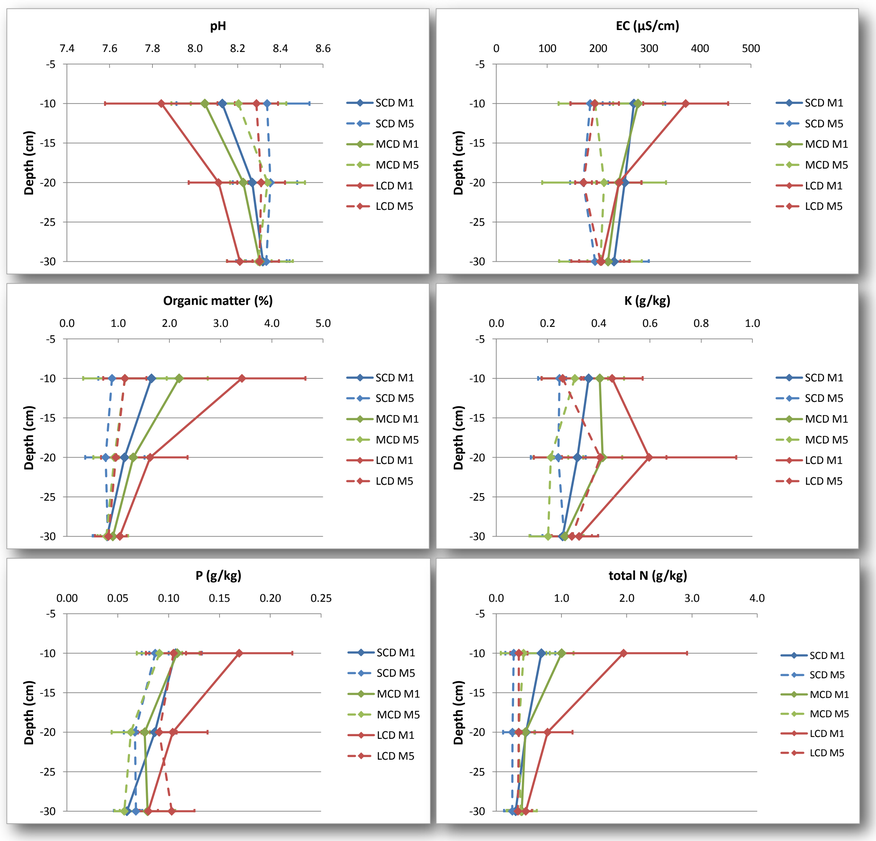
- **SOIL ANALYSIS**
  - texture, organic matter (OM), $CaCO_3$, pH and electrical conductivity (EC)
  - soluble cation concentrations (Ca^{2+}, K^+, Mg^{2+} and Na^+) and available phosphorus (P) were determined using ICP-AES (ICAP 6000 series, Thermo scientific)
  - total C and total N were measured with CNS analyzer (Variomax)

RESULTS AND DISCUSSION

- Increase in **pH** with increasing distance from tree. Higher pH at SCD compared to MCD and LCD.
- Decrease in **EC** with increasing distance. No influence of canopy size.
- Decrease in **OM** from microsite M1 to M5. Higher OM content for LCD and MCD compared to SCD.
- Decrease in **soluble K** along microsite gradient. No differences between canopy sizes.
- Decrease in **available P** with increasing distance from tree. No influence of canopy size.
- Decrease in **total N** along microsite gradient. Higher total N content for LCD and MCD compared to SCD.



- Increase in **pH** with depth at M1 with higher pH for SCD and MCD compared to LCD .
- Decrease in **EC** with depth at M1 but no influence of canopy size.
- Decrease in **OM** with depth at M1 and M5. Higher pH value for LCD compared to MCD and SCD at M1.
- Decrease in **soluble K** with depth at M1 and a higher amount for LCD compared to SCD.
- Decrease in **available P** with depth at M1 and M5 with a higher amount for LCD compared to MCD and SCD.
- Decrease in **total N** with depth at M1 and a higher amount for LCD compared to MCD and SCD.



CONCLUSIONS

- Levels of EC, OM, soluble K, available P and total N decreased whereas pH increased with increasing distance from tree. Levels of pH, OM and total N were also influenced by canopy size.
- Levels of EC, OM, soluble K, available P and total N decreased, while pH increased with depth at microsite M1. Levels of pH, OM, soluble K, available P and total N were also influenced by canopy size at this microsite.
- Differences in nutrient levels were largely driven by greater inputs of organic matter under trees → Acacia trees can affect the productivity and reproduction of the herbaceous ground cover.