BELOWGROUND ORGANS DIVERSITY IN SPECIES FROM THE HERBACEOUS STRATUM IN FIRE-PRONE SYSTEMS

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INTRODUCTION

Clonal growth, **vegetative regeneration** from a bud bank, and **reserve storage** are the main persistence traits associated with the plants with ***belowground organs***.

Surviving and persisting under frequent disturbances are the main challenges that perennial plants from the herbaceous layer must deal with in fire-prone systems.

Therefore, the presence of **underground storage organs** (**USO**) bearing buds might be an advantage for plants in these ecosystems[1,2].

QUESTIONS

i) Would USO in these ecosystems be morphologically similar?

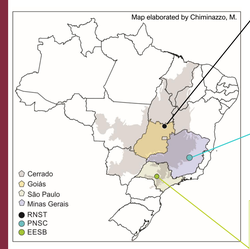
ii) Would they accumulate the same type of storage compounds?

Disjunct distribution of similar environments → ***functional convergence on the USOs?***

METHOD

USOs type: morphological identification[3]

Type of reserve: histochemical screening for the main compound' classes (carbohydrates, lipids, phenols, proteins, mucilage, and polysaccharides)[4]



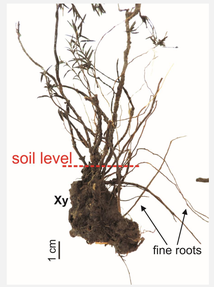
- RNST: Reserva Natural Serra do Tombador, Central Brazil; 13°35′–38′S, 47°45′–51′W; 560–1,120 m a.s.l.[5]
- **open savannas (*campo sujo*)**
- MAP 1,500-1,750 mm; MAT 25 °C
- **8 species; 3 shrubs, 8 forbs**

- PNSC: Serra do Cipó National Park Southeastern Brazil; 19°17′S, 43°33′W, 700-1670 m a.s.l.[6]
- ***campo rupestre***
- MAP 1,622 mm; MAT 21.2 °C
- **10 species: 6 shrubs, 4 forbs**

- EESB: Santa Bárbara Ecological Station, Southeastern Brazil, 700-820 m a.s.l.[7]
- **open savannas (*campo sujo*)**
- MAP 1,300 mm; MAT 20.9 °C
- **10 species: all forbs**

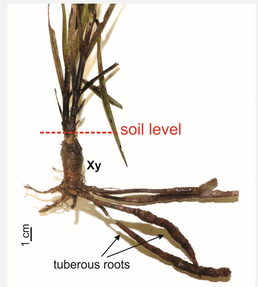
RESULTS

- Belowground organ types: **Xylopodium (Xy)** and **Root Crowns (RC)**



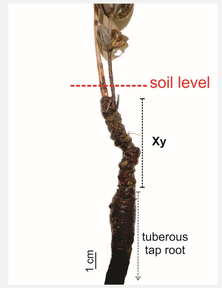
Eriope arenaria(Lamiaceae), PNSC

Xylopodium, globular with fine roots 17% of the species



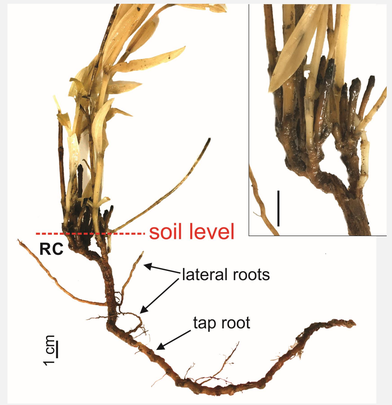
Buchnera lavandulaceae (Orobanchaceae), EESB

Xylopodium, adventitious tuberous roots 31% of the species



Diplusodum punctatus (Lythraceae), RNST

Xylopodium, tuberous tap root 52% of the species



Borreria poaya (Rubiaceae), EESB

Root crown, slighly tuberous tap root 18% of the species

Figure 1. Underground storage organs from species sampled in different open savannas and *campo rupestre* in Brazil.

Ecological implications

Xylopodia have belowground buds protected from fire by the soil (Fig 2a-b), while *Root crowns* have buds more exposed, located at the soil surface (Fig 2c-e). Also, Root crowns have a lower storage capacity due to absence of additional tuberous roots and species with this type of structure may not persist under frequent fires.

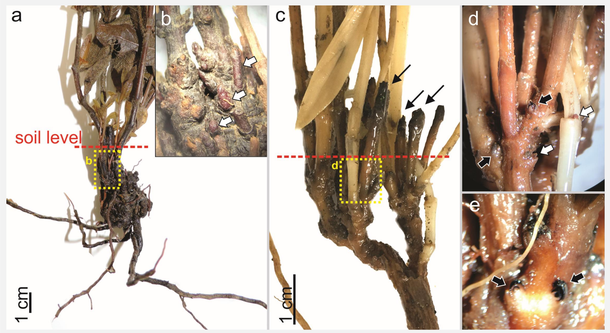


Figure 2. a-b. *Ruellia nitens* (Acanthaceae, RNST) xylopodium, globular type. Note that the buds are under the soil surface level (**b**, white arrows). **c-e**. *Borreria poaya* (Rubiaceae, EESB) root crown, old burned stems can be visualized (arrows). **d-e**. Axillary buds on detail. Scorched (black arrows) and intact buds (white arrows). In **e**, sectioned buds showing fucntio tissues.

Anatomical and histochemical investigations

Xylopodia often lacks reserves, and these are associated with the tuberous roots. However, globular xylopodia (Fig 1) store starch in parenchymatic cells from the rays and cortical regions (Fig 2).

Starch was the main storage compound in most of the species (Fig 3b-c). In some families, such as Asteraceae, fructans is the typical carbohydrate storage. Phenols, mucilage, polysaccharides, lipids and proteins were also found, mostly in specialized structures, such as idioblasts, laticifers, and internal secretory spaces.

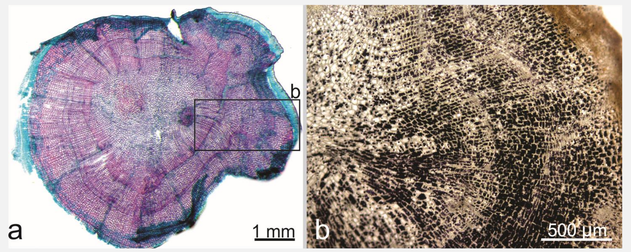


Figure 3. Globular xylopodium of *Eriope grandulosa* (Lamiaceae, RNST). **a**. Cross-section (median region of the structure) stained with safranin (red for lignified tissues) and Astra blue (blue for non-lignified tissues). Note the secondary xylem region stained in red, interspersed with radial parenchyma, where starch is stored (b). **b**. Zinc-chloride reaction for starch (starch grains stain in black), stored in the xylem rays.

CONCLUSIONS

Our results revealed that the herbaceous layer in these fire-prone communities is dominated by *two types of structures*, which are ***highly adapted to resprout after fire***, due to the high bud number and storage reserve. Thus, despite of the botanical family, growth form, and / or sampling site, they exhibited the same type of organ and similar storage compounds, suggesting that ***fire is the driver selecting species with highly adapted belowground bud-bearing storage organs***.

Expanding the knowledge about belowground plant organs, associating morphological and anatomical approaches is crucial to broaden our understanding of belowground plant community and functioning.

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