

Donuts



Effect of drought and induced nutritive stress on forest ecosystems

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Thematic action(s) concerned: WP2 WP1

Context —

The frequency of droughts in spring and summer that has increased in recent years in Europe (2013, 2015, 2018, 2019, 2020) has affected the functioning of the forest and the services it provides (wood production, storage of C, biodiversity, etc.). It has led to the decline of some forests. Among the known stresses induced by droughts (water, pathological, etc.), nutritional stress is still little studied.

Objectives —

The purpose of this project is to determine whether:

- 1- Drought lead to nutrient deficiencies in various elements (nitrogen, phosphorus, potassium, calcium, and magnesium) and the origin of these deficiencies in the forest,
- 2- A potassium deficiency affects the response of trees to the reduction of water in the soil and changes tree functioning after the drought episode,

The structure of microbial communities is affected by drought or by the double effect of drought and potassium deficiency.

Approaches —

Droughts in mature beech forests are carried out every year for 2.5 months using a removable roof below the canopy (dry plot). Biogeochemical functioning is monitored using many sensors in dry and control plot. A greenhouse experiment on young plants will monitor the behaviour of trees in the face of water and potassium stress. Microbial communities will be monitored in both types of experiments.

Key results —

As the greenhouse experiment is ongoing, the results relate only to the mature beech experiment.

- Significant differences between the two plots were observed in 2021 and 2022.
- 36% reduction in the perennial biomass increment in the drought plot
- 26% decrease in leaves in litter fallout and no change for other organ in the drought plot
- This decrease lead to the fall of leaf area index in the dry plot
- 35% increase in fine root biomass in the first 30cm of soil in the drought plot
- Decrease in potassium content in green leaves reflecting the appearance of a deficiency in the drought plot

Main conclusions including key points of discussion —

These first results confirm that drought induces potassium deficiency in this site and has a significant impact on the tree functioning.

Perspectives —

Next year, we will work (i) to identify the processes behind nutrient deficiency and determine the impact of drought on microbial community evolution in the adult tree experiment, (ii) to understand the change in tree functioning and microbial community changes during the dual effect of drought and potassium deficiency in the greenhouse experiment.

Valorization —

TURPAULT M-P, 2022. Effet des sécheresses répétées sur le fonctionnement biologique et biochimique des écosystèmes forestiers. Expérimentations sur le site de Montiers (Meuse). Colloque Climae, 23 et 24 Novembre, date, Versailles, France. [Short oral communication, Poster and abstract].

TOUCHE J., DE DONATO Ph., CALVARUSO C., TURPAULT M-P., 2022 Impacts of drought events on the biogeochemical cycles in a temperate beech forest. Goldschmidt conference, July 10-15 2022, Honolulu, HI, USA. [Oral communication and abstract]