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► **To cite this version:**

Celestino Quintela Sabaris, Guillaume Echevarria, Sophie Leguédois. Ecological Restoration of Ultramafic Soils: Organic Amendments and Plant Functional Traits. Conseil Scientifique LabEx Ressources 21, Jan 2017, Nancy, France. 2017. hal-01662247

**HAL Id: hal-01662247**

**<https://hal.science/hal-01662247>**

Submitted on 12 Dec 2017

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# Ecological Restoration of Ultramafic Soils: organic amendments and plant functional traits

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## Scientific issues

- Mining activities worsen extreme soil conditions in ultramafic areas.
- Ecological succession provides a low-cost nature-assisted tool for restoring postmining environments.
- Some critical factors (e.g. lack of initial nutrient stock in soils, soil toxicity, low immigration of seeds and soil biota) may impede the onset of ecological succession processes.
- Identification of soil amendments and well-performing plant species needed for successful ecological restoration.

## State of the art

- Passive restoration (i.e. no planting) can be a effective way to recover a functioning ecosystem on disturbed areas.
- In some cases soil fertilisation is needed to provide a nutrient stock to start ecosystem recovery. Locally-produced oil-palm wastes can be a green low-cost soil amendment.
- Plant functional traits determine plant performance in response to different environmental factors.
- These traits can be used for the selection of interesting species for ecological restoration.



▲ Unvegetated serpentine accumulation at Garas site. Pioneer vegetation, plant functional traits and mesocosm. ▼



## Results

Mesocosm experiment:

- Organic amendment had a slight acidifying effect on soil, although this effect has been lost after 3 months.
- Control and decompaction treatments had higher plant colonisation than organic amendments.

Vegetation on ultramafic disturbed areas:

- 50% of bare soil on ultramafic rocky tailings.
- Dominant vegetation grasses (Poaceae) and sedges (Cyperaceae). Shallow root systems (less than 30 cm depth).
- Plants/litter cover almost 100% of burnt areas.
- Ferns (mainly the bracken fern *Pteridium esculentum*) are the dominant species.
- High prevalence of vegetative spreading (mainly rhizomes).

## Perspectives

- **Mesocosm experiment** to be finished on July 2017. Obtained data valuable for feeding into models of early evolution of technosols.
- Planned **soil aging experiment** (spring 2017) to assess soil evolution along longer periods.
- Physico-chemical and microbiological soil analyses of disturbed ultramafic plots (pending on samples importation).
- **List of 14 functional traits** to evaluate plant strategies on ultramafic disturbed habitats (pending on samples importation).
- A **third field mission** planned for summer 2017: analysis of nutrient flow and pedogenesis by pioneer tree species on serpentine quarry.

## Methodological approach

**Two field mission on Sabah ultramafic areas** (Malaysian Borneo).

**Amelioration of recolonization of ultramafic technosols** → mesocosm experiment. Plant cover surveyed each two weeks, leached water sampled each month.

**15 sampling plots** on serpentine quarry tailings and rocky wastes and on serpentine burnt areas. Soil and plant samples collected. Soil cover described. Plant species identification not finished yet. Several **functional traits** have been registered from field observations, database will be completed upon samples arrival at France.

