

# Study report on the fertility and quality of soils and composts in Dschang and Lausanne

## 1. Summary

This comparative study focuses on two diametrically different contexts of urban agriculture: in Dschang, in Cameroon, as subsistence agriculture and in Lausanne, in Switzerland, as recreational gardening. The objectives are to highlight and compare the fertility and the quality of soils within the two cities, as well as to analyze the quality of composts.

Results highlight important differences between the two cities: a) **Contamination by heavy trace metals and microplastics is greater in Lausanne than in Dschang.** b) **Soils have good fertility in both cities, but nutrient contents vary.** c) **The parent material, which is very different between the two countries, influences the levels of nutrients and trace elements in soils and composts.**

## 2. Introduction

Chemical fertility corresponds to macro and micro-nutrients contents and bioavailability, essential for plant life cycle (Ordonnance du 1er juillet 1998 sur les atteintes portées aux sols (OSol), 1998; Sanchez, 2019). The elements N, P, K, Mg and Ca are among the essential macronutrients, which must be present in relatively large quantities in soils.

Soil quality is the ability of soils to carry out some ecological functions, reflecting a combination of physical, chemical and biological properties (Weil & Brady, 2017).

## 3. Materials and methods

To answer the research questions, it is essential to know the physical-chemical-biological characteristics of soils and composts.

Analyses such as pH, conductivity or granulometry make it possible to provide information on the fertility and quality of the soils. To identify fertility more precisely, analyses of bioavailable nutrients (Mehlich III) and CEC, were carried out. In addition, CHN and carbonate loss (quantified the OC) analyses were carried out. The biological fertility of few Lausanne soils was achieved by observing the micro-mesofauna of the soil, via Berlese funnel extraction method (Coineau, 1974). Regarding soils quality, the XRF analysis was carried out to identify the HTMs present. Analysis of microplastics was done. On composts, the same analyses were carried out (except granulometry). All these analyses are complementary and allow a global and relatively complete view of the characteristics highlighting the fertility and the quality of soils and composts.

## 4. Main results and Discussion

### 3.1. Chemical fertility

#### 3.1.1. Soils

	Cation exchange capacity	Bioavailable Phosphorus	Bioavailable Potassium	Bioavailable Magnesium	Organic Carbon
Dschang	++	—	+	+	±
Lausanne	+	++	+	+	++

- ◆ **Swiss soils contain a great deal of all nutrients** while the soils of Dschang are deficient in P and the saturation of the absorbent complex is strongly occupied by Calcium (Ca) and Magnesium (Mg). Tropical soils are poorly provided with these two elements, because they are rapidly leached → The city of Dschang is located very close to Mount Bamboutos, on the Volcanic Line of Cameroon. So **Dschang sits on ancient volcanic deposits which could be the source of a better fertility** than expected for tropical soils of this age.
- ◆ The geological situation of Dschang could explain its high CEC, and nutrient content (except P) and therefore its good fertility.
- ◆ A severe **lack of P in Dschang** remains in agricultural soils. → In view of this P deficiency of the soils of Dschang, it would be interesting to use as an amendment a rich in P compost: **agro-compost seems to be a solution that might work to fill the P deficiency**. This mixture of composts with animal droppings greatly changes the nutrient content.

#### 3.1.2. Composts

- ◆ **The agrocompost**, is the only Dschang compost with a really high phosphorous and magnesium content. → **good as amendment**
- ◆ Nitrogen content is globally within the expected values. The C/N ratio is quite similar in all composts, except for compost of Sinteu which is higher than all others N is the first limiting nutrient, and it is really important to know its bioavailability, and not only the total value. Total nitrogen content is similar between the two countries. The ratio Carbon/Nitrogen gives a good idea of the availability of nitrogen, the lower the ratio the more N is available.
  - **!! Sinteu compost has a C/N ratio that is very high**, indicating the lack of available N, or even a consumption of soil available N by microorganisms, **leading to a deterioration of soil fertility to which it is applied!!**

### 3.2. Contamination

#### 3.2.1. Soils

- ◆ **Lead, zinc, copper and chromium** are found in greater quantities in all **Lausanne soils**, with some sites exceeding the investigative threshold values of Osol.
  - The intense Pb pollution may be old, knowing that several trace element have been used by humans for several thousands of years (Alloway, 2013), or via wind or water deposits, linked to automobile traffic, and to city development.

- The Ntsue site may be the oldest in Dschang and has accumulated more HTMs than other soils. Its geographical location, next to the major axis Dschang-Baffoussam, can be the cause of a strong lead pollution due to traffic intensity.
- ◆ **Topsoils of Lausanne contain more MP than Topsoils of Dschang.** AFC site is slightly higher than the other in Dschang.

### 3.2.2. Composts

- ◆ Cadmium is present in Ngui site (in agro- and municipal compost) of Dschang, but not in the others. In Switzerland, only the municipal compost contains cadmium. All three composts exceed the allowable limit for cadmium.
  - Cd may come from battery present in organic waste before sorting (Temgoua et al., 2014).
- ◆ Chromium, copper, lead, nickel and zinc are in all composts. Except for chromium, all the composts of **Dschang are below the admissible** value. Several composts from Lausanne still above the admissible standard for all these trace elements. **More than half of composts are too high in chromium, copper and nickel**
  - Swiss compost is more often above the acceptable standards for metal pollutants.

## 5. Conclusion

Regarding soil fertility: Swiss soils contain more Organic Carbon (and therefore OM) than Dschang soils, and despite a slightly lower CEC, **Lausanne soils have essential nutrient values well beyond the "satisfactory" threshold.** It is known that tropical soils are less fertile than temperate soils. Nevertheless, **Dschang soils are not infertile, having a significant CEC and sufficient levels of macro and micro-nutrients (except P), to have good fertility.** In addition, the soil structure in both countries is good and ensures good physical fertility.

In general, **the soils of Lausanne are more polluted by trace element and by microplastics** than the soils of Dschang. It is therefore admissible to say that **the soils of Lausanne are of lower quality** than the soils of Dschang.

**Agrocomposts seem to be a good amendment to address the soils P deficiency,** in complement to other P fertilizer. The CNFS composts seem a little too contaminated with HTMs to be adequate for regular use. **Sinteu compost is the least contaminated, however, its N deficient make it not ideal for agriculture,** which requires a lot of nitrogen, despite its low HTMs content.

Regarding contamination, **Swiss composts are much more contaminated by trace element than Dschang composts.** They are mainly affected by geogenic trace element, absent from Lausanne soils. Trace element are recognized as problematic, so the quality of Swiss composts is unsatisfactory.

From a fertility point of view, the composts from Lausanne and Dschang have different characteristics, particularly regarding nutrients. Regarding C/N ratio, CEC, OC and all the variables related to fertility, neither country seems to have poorer composts than the other (except Sinteu compost); they are simply different, by their inputs and their management.