ARTICLE IN PRESS

Applied Soil Ecology xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Applied Soil Ecology

journal homepage: www.elsevier.com/locate/apsoil

Short communication

Influence of connectivity & topsoil management practices of a constructed technosol on pedofauna colonization: A field study

Coralie Burrow*

LGCgE, University of Lille 1, France

ARTICLE INFO

Keywords:
Soil fauna
Technosol
Soil restoration
Connectivity
Differential management
Bioindicators

ABSTRACT

At the present time, rehabilitation of polluted urban areas and the restoration of their soil are environmental priorities. The creation of constructed soils appears to be a tempting way to restore, lastingly, a contaminated urban soil provided that they can become fertile and host a functional biodiversity delivering essential ecosystem services.

To ensure this, the recolonization of newly established technosols composed of a mixture of compost and *in situ* deep alluvion was monitored using judiciously chosen bioindicators: springtails, mites, earthworms, carabid beetles and woodlice. These technosols were part of an experimental plot located inside the future "Ecoquartier de l'Union" (Roubaix, France).

The results show that, if the connection of the technosols with an element of the local landscape (in this case a railway hedgerow) plays a part chiefly in aiding the first stages of recolonization, notably for earthworms and springtails, technosols management has a lasting impact on the colonization dynamics and the implantation of the different taxa.

Establishing an herbaceous cover (flowering meadow, lawn) or a hedge was especially profitable to the pedofaunic communities, which were richer and more abundant, as well as to the technosols functioning (better litter degradation, diversified collembolan communities with regards to functional traits). The same is true for the addition of RCW (Ramial Chipped Wood) which benefits earthworm and mesofauna through the organic components released and the associated fungal development.

1. Introduction

Numerous sustainable urban projects based on the redevelopment of urban brownfields are currently scattering in France in order to deal with urban sprawl and with the soil artificialization issue.

Located in Roubaix (59) in the Nord-Pas-de-Calais region, the « Ecoquartier de l'Union » is one of the major urban regeneration projects in France, consisting in the redevelopment of 80 hectares of brownfield land characterized by highly polluted soils. Many scientific experiments are conducted on this workshop site from the ADEME SAFIR network.

In the future green spaces, it has been decided to create constructed soils, called technosols, using the less contaminated soil horizons associated with organic wastes and demolition by-products.This soil construction process, which allows both waste recycling and urban soil remediation, consists in a mixture of original silt and green-waste compost put on the top of a backfill layer made of demolition by-products (Fig. 1).

The aim of this study was to determine whether constructed technosols could become fertile and functional soils, integrated in the urban green network. This raises numerous questions:

- Which soil fauna will colonize these technosols and how fast?
- How to favour this colonization process?

Does soil connectivity have an influence on the colonization process? In other words, does the brown infrastructure, as defined by Pouyat et al. (2010), play a role in soil fauna colonization dynamics of constructed soils in urban ecosystems?

Which management practices of the technosol's upper layer is the most suitable for the establishment of a functional soil fauna community?

- Do soil invertebrates prove to be relevant bioindicators to assess the evolution of technosols quality and functionality?

*Abbreviation:*RCW, Ramial Chipped Wood

* Corresponding author at: audicé environnement, ZAC du Chevalement, 5 rue des Molettes, 59286 Roost-Warendin, France. Phone: 07 61 49 91 29.
E-mail address: coralieburrow@aol.com.

https://doi.org/10.1016/j.apsoil.2017.12.001
Received 27 November 2017; Received in revised form 28 November 2017; Accepted 4 December 2017
0929-1393/

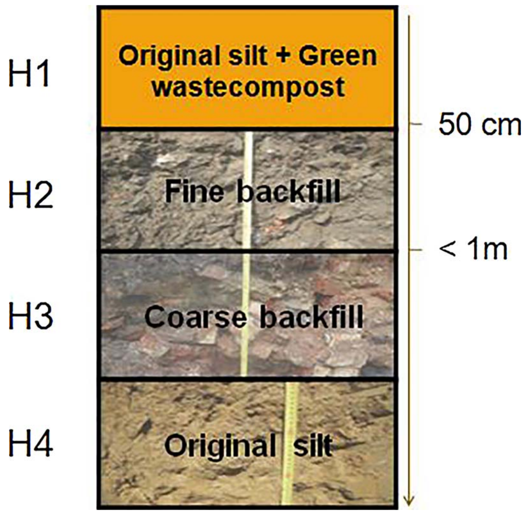

Fig. 1. Technosol profile.
This figure shows the four pedological horizons of the constructed technosol.

2. Material and methods

To answer these questions, experimental plots have been set up *in situ*, on the Union brownfield (Fig. 2) on October 2012, to monitor the colonization of constructed technosols by several soil invertebrates according to different topsoil management practices and levels of connectivity.

Influence of connectivity to the surrounding ecological network has been assessed by putting one experimental plot near a hedgerow (“H”) whereas the other plot was disconnected from any potential ecological corridor (“NC”) (Figs. 3 and 4).

Each of these two experimental plots consist in 8 adjacent strips (15 m long X 3 m wide) corresponding to the same 8 different topsoil management practices.

Technosol recolonization was monitored *via* soil samples for Collembola and Acari, pitfall traps for Isopoda and Carabidae and the AITC technique for earthworms (Fig. 5). A litterbag experimentation has also been conducted to assess litter decomposition rate.

3. Results and discussion

3.1. Which soil fauna will colonize these technosols and how fast?

First months results indicate that colonization by macrofauna is relatively slow and faster for mesofauna, especially for Collembola, which corroborates results found in some previous studies (BIOTECHNOSOL, 2013; Dunger et al., 2002; Hutson, 1980; Koehler, 2000; Pey, 2010).

Thus, 8 months after the settlement of the technosols, more than 2000 springtails per square metre were found on average in the experimental plots.

4.5 species of Collembola have been recorded during the 20 months of monitoring, mostly “fast-dispersal species” *i.e.* highly mobile epigeic species (well developed furca & legs) or wind dispersed species. Euedaphic species represent less than 15% of total collembolan abundance which is not surprizing in such recently disturbed soils (Parisi et al., 2005; RMQS-Biodiv, 2009).

During the first 20 months of technosol colonization, macrofauna taxa showed very low abundances and specific richness (5 species of earthworms, 27 of carabids and 4 of woodlice). In 2013, that is the year following the technosols settlement, mainly predator organisms were found (arachnids, beetles, hymenoptera) whereas in 2014, more diverse communities appeared with the arrival of phytophagous or saprophagous taxa like woodlice and gastropods.

Like collembola, earthworms species that colonized the experimental plots were mainly « good dispersers », living at the soil surface, *i.e.* epi-anecic species. As for carabid beetles, communities were dominated by small predator macropterous species.

Whatever the taxa being considered, the same trend arose with most of the organisms sampled being surface-dwelling species with good dispersion abilities. We also could define 4 main categories of organisms in the communities found in the constructed technosols :

- Xero-thermophilous grassland or coastal species, frequently encountered in urban ecosystems (Niemela et al., 2011; Sattler et al., 2011);
- Species bring or favoured by the compost composing the surface horizon of the technosols;
- Pionneer species;
- Ubiquist species, also sampled in the surroundings of the experimental plots, which progressively dominate the communities.

Hence, these first results show that constructed technosols can host quite diversified pedofaunal communities given the urban context. These communities show some similarities with those sampled in the surrounding of the experimental plots but also present specific features given the existence of environmental filters such as dispersion, biotic and abiotic constraints (Belyea and Lancaster, 1999; Keddy, 1992).

3.2. How to favour this colonization process?

3.2.1. Soil connectivity

Specific richness and abundance were significantly higher in the hedgerow-connected plot (H), for Collembola and macrofauna as a whole (total abundance of the organisms caught in the pitfall traps, not presented here) at the beginning of the colonization process.

Hence, collembolan abundance was nearly eight times higher and specific richness twice as big in the connected plot compared to the disconnected one (Fig. 6).

This positive impact of connectivity on the colonization process of the technosols lasts longer for earthworms. Even 3 years after the settlement of the experimental plots, their abundance was nearly twice as

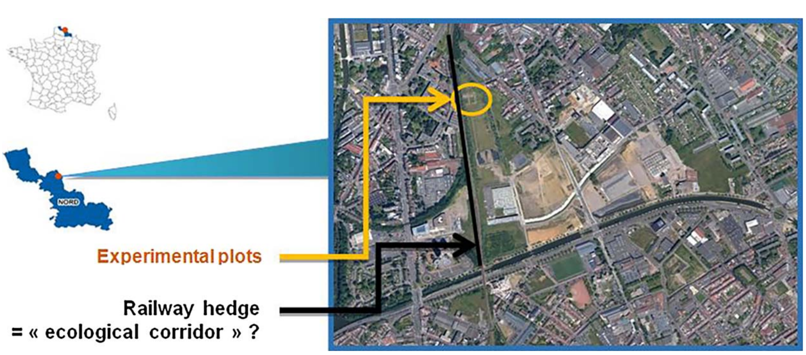

Fig. 2. Location of the study site and the experimental plots.