MŰEGYETEM 1782

SCALE-UP EXPERIMENTS FOR COMPOSING CULTIVATION MEDIA FROM DEGRADED SOILS AND WASTE AMENDMENTS

Orsolya Klebercz, Tamás Böröndi, Zoltán Magos, Viktória Feigl, Nikolett Uzinger and Katalin Gruiz
Budapest University of Technology and Economics, Department of Applied Biotechnology and Food Science,
H-1111 Budapest, Szent Gellért tér 4., Phone: +361-4632347, E-mail: oklebercz@mail.bme.hu

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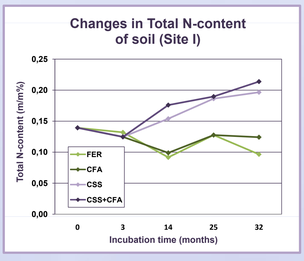
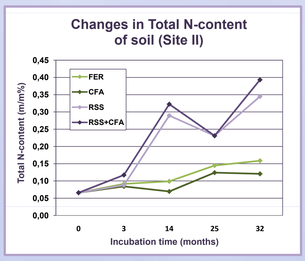




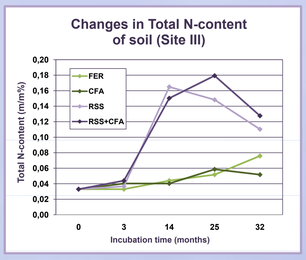


Figure 1. Changes in Total N-content of the soil of the three field plots before and after the addition of waste amendments

A special area of soil protection is the substitution of soil by materials composed from wastes and bad quality soils. The present study examines the possibility to create soil substitute for land revitalization by in-situ mixing of bad quality subsoil managed as inert waste and different kinds of sewage sludges and fly ashes in a scale-up experiment.

Our demonstration site is located at the communal waste landfill of .A.S.A. Hungary Ltd. in Gyál, near Budapest. The ringwall material of .A.S.A. landfill is very heterogeneous, typically low in organic matter and nutrients and constitutes the surface layer of the deposit from the start of landfilling till the final recultivation in the next 10 or more years. Therefore temporary vegetation is needed to protect the steep ringwall from erosion and improve the esthetical view of the deposit close to the residential area. At three sites, 3x9 m^2 field plots were amended with the combination of the best performing organic and inorganic wastes, acording to the results of prior microcosm experiment. Soil sampling and analysis were carried out after 0, 3, 14, 17, 25 and 32 months.

Waste amendments used in the experiment:

Raw sewage sludge (RSS, 10 m%) from a small town near Budapest (Telki), originating from Living Machine Technology (Organica Water Inc.)

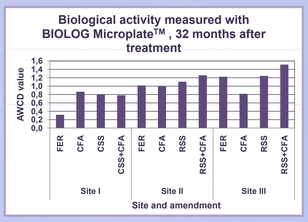
Composted sewage sludge (CSS, 10 m%) from Hódmezővásárhely (.A.S.A. Hungary)

Coal combustion fly ash (CFA, 2 m%) originated from North-East Hungary (Mátrai Power Plant)

28.09.2010. Right after grass planting

28.10.2010. One month after planting

21,05.2011. Spring vegetation



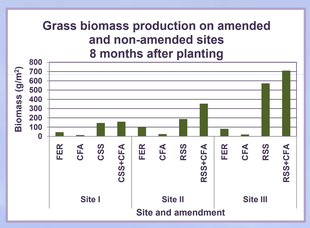


Figure 2. Changes in biological activity and grass yield on the field plots before and after the addition of wastes

Effect on soil nutrient content, soil biological activity and plant growth

Treatments were able to provide satisfactory source of all main nutrients (Humus content, Total N, available P and K content). Since nitrogen is the main factor influencing plant yield for grasses, due to the lack of space, we only present here the charts for total N **(Figure 1).**

We can see that CSS amendment caused a stabile growth of 30–300% in Total N. RSS also raised Total N, but this effect didn't prove as stabile as in the case of CSS: at Site 3, 60% of the additional nitrogen was already gone by the 32th month after application. As we can see in all three cases, CFA alone didn't raise N-content significantly, but it amplifies the effect of organic amendments, therefore their joint application is suggestible.

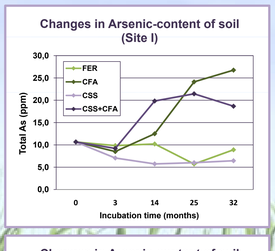
Similar tendencies could be observed in the case of Humus content, and for P and K. Altogether, although effect of the amendment varies on a wide scale, sewage sludges proved to increase effectively all of the main nutrient contents. CSS and RSS could even provide nutrients for the soil in excess. CFA alone isn't enough as nutrient source for all macronutrients, but added together with organic amendments it can support and elongate their positive effect.

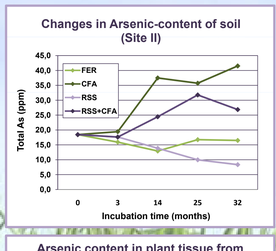
Since all nutrients in the amended soils were present in excess, we can even consider lowering application rates form 10% to 5% or less, taking into account the bottleneck factor of our nutrient stock (nitrogen). By this we are reducing not only the necessary amount of soil amendments, but also the risk of the leaching of nutrient into surface or subsurface waters. On the insulated surface of a waste landfill, excess nutrient doesn't pose a risk to the environment, but when applying within different circumstances (e.g. roadside revegetation etc), application rates must be chosen carefully to avoid eutrophication of natural waters.

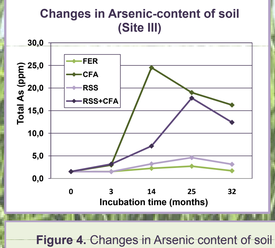
Figure 2. illustrates that with one exception (CFA) discussed later, all amendments in all soil types could increase biological activity compared to artificial fertilizing (FER). The effect is even more eye-catching observing grass yields: more than tenfold increase was achieved compared to control (FER). Grass yield data point out a curious trend. While toxic effect of CFA alone can be observed in all three sites (on Site III also visible in AWCD data), SS+CFA amendment produced the best yields in the case of all soil types.

Effect on toxicity and metal content

Toxicity of CFA is assumedly caused by the arsenic content of CFA. This can be supported by depicting the total arsenic content of the soils after the addition of the amendments (Figure 9.). Although the preliminary examination of wastes didn't show alerting quantity of toxic metals, increased arsenic content is clearly visible in all sites, both in CFA and SS+CFA treated soils. This fact points out that major inhomogenities in waste amendments make it difficult to ensure their safe application. Nevertheless our results implicate that although total As in CFA amended soils is higher than acceptable (10 ppm according to Hungarian regulations), the plant uptake of arsenic might be greatly restricted by the addition of sewage sludge: despite the high As content of grass grown on CFA-treated soil of Site II and Site III, no increase compared to control is observed in grass grown on RSS+CFA-amended soils. The connection of total As and plant available As is rather complicated and not well described yet (Martínez-Sánchez, 2011), but since environmental risk is expressed trough plant available metal content, our results, confirmed by others too (e.g. Karczewska et al., 2012) show that sewage sludge might be able to bind arsenic permanently and therefore decrease environmental risk to acceptable level.







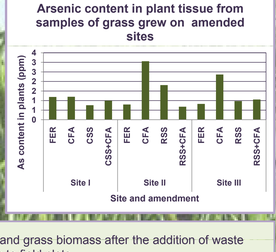


Figure 4. Changes in Arsenic content of soil and grass biomass after the addition of waste amendments to field plots

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