# Sewage sludge and tree pruning residue use in the recovery of degraded area and their effects on epigeic invertebrates of Brazilian Savannah soil

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The use of residues, such as stabilized sewage sludge (SS) from treated waste water (Corrêa *et al*, 2010) and tree pruning residue, as source of organic matter for degraded soil is a low-cost strategy of great environmental appeal, once it allows for the reuse of residues and favors recovery of degraded areas, providing carbon and mineral nutrients for plants and other organisms. When the vegetation is inserted into a degraded area, deposition of the organic matter on the soil takes place, whether by rhizodeposition or by falling leaves and other plant debris. These materials create a favorable habitat for the occurrence of heterotrophic microbial community and soil fauna (Paul, 2007).

It is strategic to monitor the soil macrofauna in areas under recovery process, once these organisms react to the various anthropic interventions in the environment and act as biological indicators of soil quality (Lavelle *et al*, 2006). Efforts have been made to evaluate the influence of using organic matter in the form of sewage sludge and tree pruning residue on the recovery of a gravel pit in Brasília (Federal District), specifically by studying the diversity and abundance of epigeic invertebrates and the to determine which environmental variables (chemical or biochemical) best explain epigeic invertebrates community distribution .

An experiment was conducted in a large degraded area North of highway DF-087 (*Via Estrutural*) and West of highway DF-003 (*EPIA)*, located in the capital of Brazil, Federal District (15°46'32''S; 47°56'56"W). The experiment design consisted of a full factorial, with two factors (sewage sludge and pruning residue) in three dosage levels (sludge: 0, 270 and 1080 $m^3$ $ha^{-1}$; pruning residue: 0, 122,5 and 245 Mg $ha^{-1}$), with 3 replications placed in blocks, in a total of 27 plots. Each plot had 100 $m^2$ (5 x 20m), where 60 seedlings of 10 different woody native Savannah species (6 seedlings/specie) were planted in distances of 2m x 1m. Epigeic invertebrates sampling was performed using the "Pitfall traps" sampling method, by installing four traps distributed in each plot during the rainy season (March 2016) and the dry season (August 2016), which were kept in the area for 7 days. The traps consisted in plastic pots of 8 cm in diameter and 500 mL capacity, installed with the openings close to the soil surface, filled with 250 mL 0.5% (v/v) alcohol solution. The characterization of the organisms were conducted by determining the number of individuals based on taxonomic composition (grouped by order) (%), total number of individuals in the experimental area, relative frequency in each area, density (number of individuals per fraction) and abundance (number of groups). At the same sampling period, litter deposition was also evaluated by using a 25 x 25 cm frame. Soil chemical and biochemical attributes are currently being analyzed at 0-10cm depth, to stablish links between these environmental variables and the density and diversity of soil epigeic invertebrates, by multivariable statistic methods.

The addition of sewage sludge and tree pruning residues has stimulated litter deposition of woody species, but it has not promoted significantly difference when compared to the degraded area (Figure 1a and 1b). The largest litter depositions were observed in the combination of 270 $m^3.ha^{-1}$ of sludge and 245 Mg $ha^{-1}$ of tree pruning residue, during both the rainy and the dry seasons (0,55 e 1,87 kg $m^{-2}$), totaling 2 and 4 times fold more than the results observed in the degraded area (0,05 e 0,42 kg $m^{-2}$). The sampling season of epigeic invertebrates evaluations has not influenced the total number of individuals captured by the pitfall traps (4010 and 5547 individuals collected during the rainy and dry seasons, respectively), with 11 taxonomic groups being identified during the rainy season and 14 during the dry season.

The predominance of Hymenoptera and Coleoptera groups during the rainy season (58,7% and 11,2%, respectively) and the dry season (85,1% and 7,2%, respectively) became a remarkable characteristic of all treatments (Figure 2). The abundance of individuals in these groups is possibly associated with the introduction of litter deposition from the woody species, notably Coleoptera, which also contribute for the addition of organic matter at soil depths (Lima et al., 2010). The low occurrence of predators, such as Aracnidae and Scorpiones, indicates that the trophic chain of soil organisms is still being formed in the recovery areas.

Vegetation settling in degraded areas is directly related to the addition of organic matter into the soil, thus favoring the soil organism community (Vasconcellos et al., 2013). Recovery of degraded areas by incorporating organic matter to the soil, from sewage sludge or from tree pruning residue, has stimulated litter deposition from the woody species introduced in the area, although the 24-month timeframe has proved insufficient in the promotion of relevant changes in the epigeic invertebrate community dynamics, which emphasizes the need for continued monitoring or these organisms in the analyzed area.

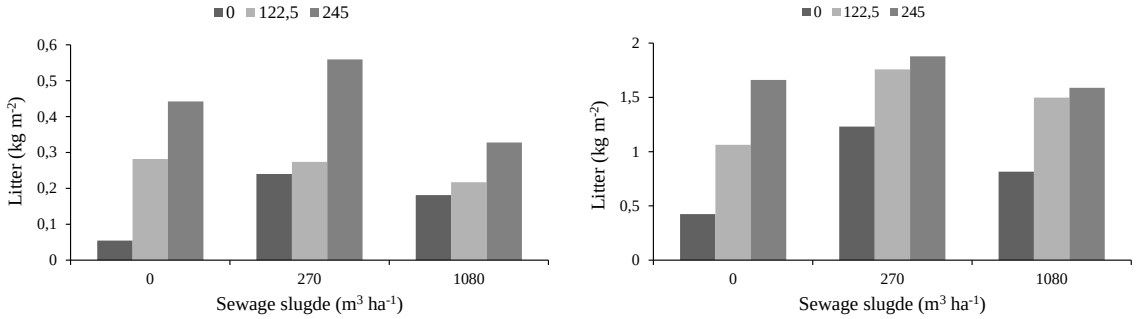
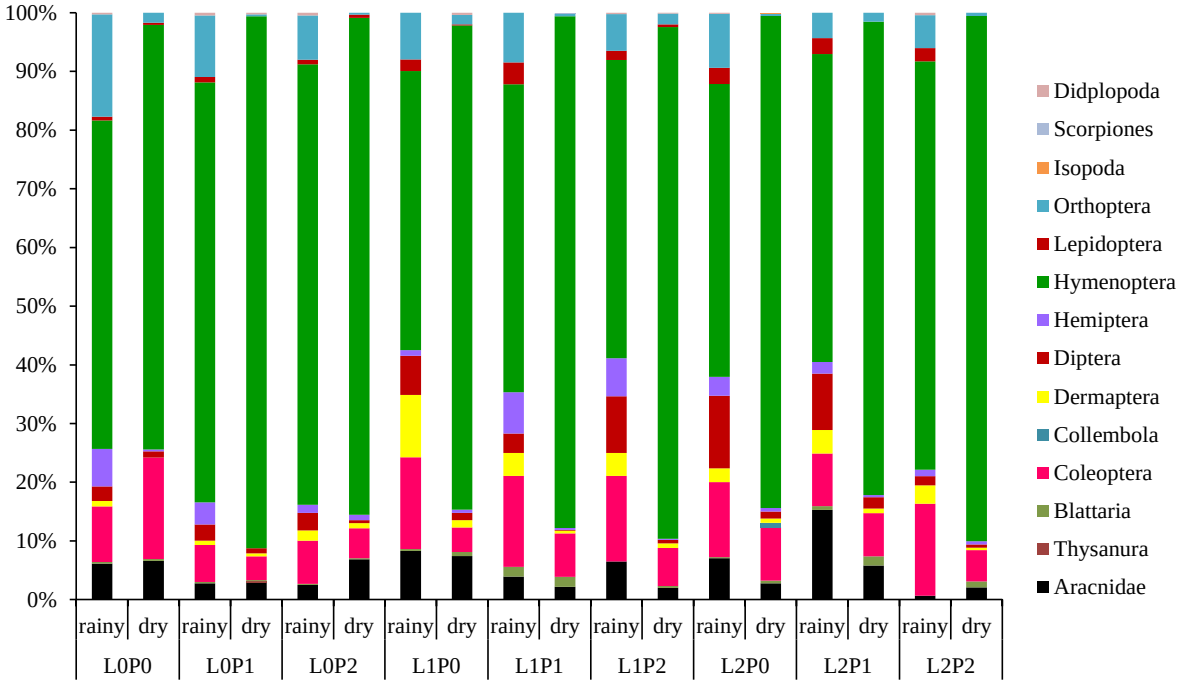



Figure 1. Deposited litter (kg $m^{-2}$) on the ground of degraded area under recovery, with dosages of sewage sludge (0, 270 and 1080 $m^3$ $ha^{-1}$) and of tree pruning residue (vertical bars: 0, 122,5 and 245 Mg $ha^{-1}$), during the rainy season (a) and the dry season (b), in the Savannah Region, Federal District, Brazil.




Graphic 2. Relative abundance of *taxa* found in the soil of the degraded area under recovery, with dosages of sewage sludge (L0=0, L1=270 e L2=1080 $m^3$ $ha^{-1}$) and of tree pruning residue (P0=0, P1=122,5 and P2=245 Mg $ha^{-1}$), during the rainy and the dry seasons in the Savannah Region, Federal District, Brazil.

REFERENCES

Corrêa, R.S.; Bento, M.A.B. Quality of a revegeted mine spoil in the Federal District of Brazil. R. Bras. Ci. Solo, 34:1435-1443, 2010.

LAVELLE, P. et al. Soil invertebrates and ecosystem services. European Journal on Soil Biology, v. 42, Supplement 1, p. S3-S15, 2006.

Paul, E.A. Soil Microbiology, Ecology and Biochemistry. 3rd Ed. Academic Press. 2007.

Vasconcellos, R.L.F.; Segat, J.C.; Bonfim, J.A.; Baretta, D.; Cardoso, E.J.B.N. Soil macrofauna as an indicator of soil quality in an undisturbed riparian forest and recovering sites of different ages. European Journal of Soil Biology 58 (2013) 105-112.