Microbial Biomass and Activity in High-Mn Soils Fertilized with by-Products of the Intermediate Processes of Tanning

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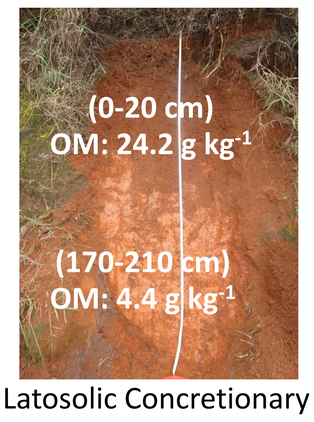
ABSTRACT

The hexavalent form of Cr is known to cause environmental and health problems due to its high toxicity. Oxidation of Cr(III) to Cr(VI) might occur in Mn-oxide rich soils at pH above 5.5 and under conditions of low organic matter content. Cr(VI) can inhibit plant growth and development, contaminate water resources and also change the structure of the soil microbial community. The objective of this work was to assess changes in microbial biomass and activity in A and B horizons of two different soils containing high contents of manganese oxides (up to 75,000 mg kg^{-1}) and/or Cr (up to 18,000 mg kg^{-1}), which were incubated with a by-product of the tannery industry, used as a nitrogen fertilizer (total N ~ 12%, total Cr ~ 2.5%). Biomass carbon and microbial respiration increased in A horizons following the application of the by-product, except for the soil with the lowest Cr concentration. After 15 days of application, carbon of the microbial biomass was reduced in B horizons and increasing concentration of urease were detected in all soils. High concentrations of ß-glucosidase were detected in A horizons, regardless of the application of the by-product. Such study will help us to elucidate how the native levels of Mn (and Cr) and the addition of the leather tanning by-product containing Cr affects the ecological equilibrium of the soil, with further evaluation of the microbial biomass along with its C and N content, as well as enzymatic activity (urease, β-glucosidase and acid phosphatase) and induced respiration, as such measurements are of great importance for studies regarding soil quality.

OBJECTIVE

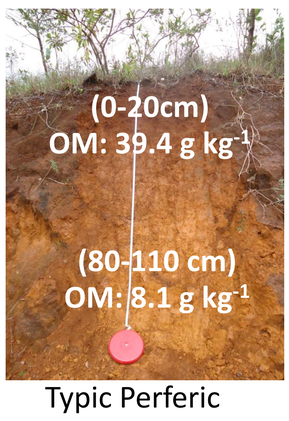
The objective of this work was to assess changes in microbial biomass and activity in A and B horizons of two different soils containing high contents of manganese oxides (up to 75,000 mg kg^{-1}) and/or Cr (up to 18,000 mg kg^{-1}), which were incubated with a by-product of the tannery industry, used as a nitrogen fertilizer.

MATERIALS AND METHODS



Latosolic Concretionary Petric Plinthosol

$\uparrow Mn^{4+} \downarrow Cr$



Typic Perferic Red-Yellow Latosol

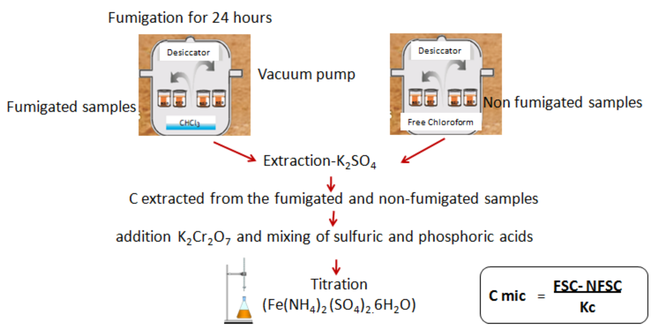
$\uparrow Mn^{4+} \uparrow Cr$

Experimental Setup

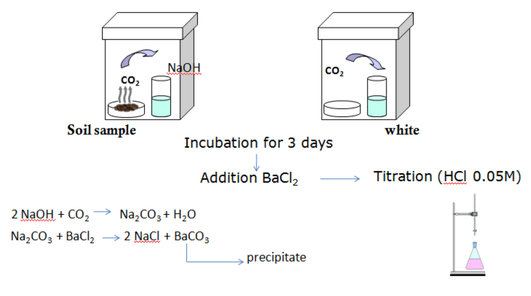
144 plots = 2 soils x 2 horizons x 3 reps x 6 sampling times (0, 15, 45, 75, 105, 135 d) x 2 N rates (0 and 300 mg N kg^{-1}, from the by-product: hydrolyzed leather, 12% N; 8876 mg kg^{-1} labile Cr; 0.8 mg kg^{-1} Cr(VI))

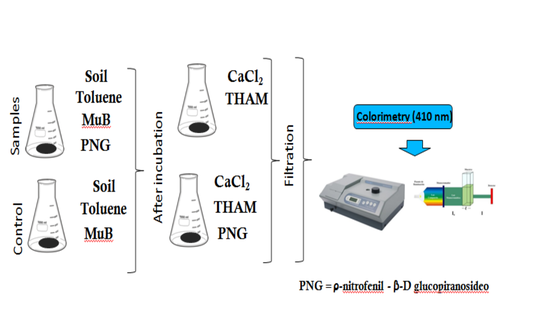
β-glucosidase activity

Microbial biomass C (MBC)

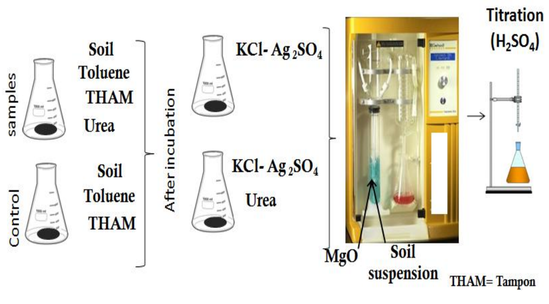


Soil basal respiration (SBR)

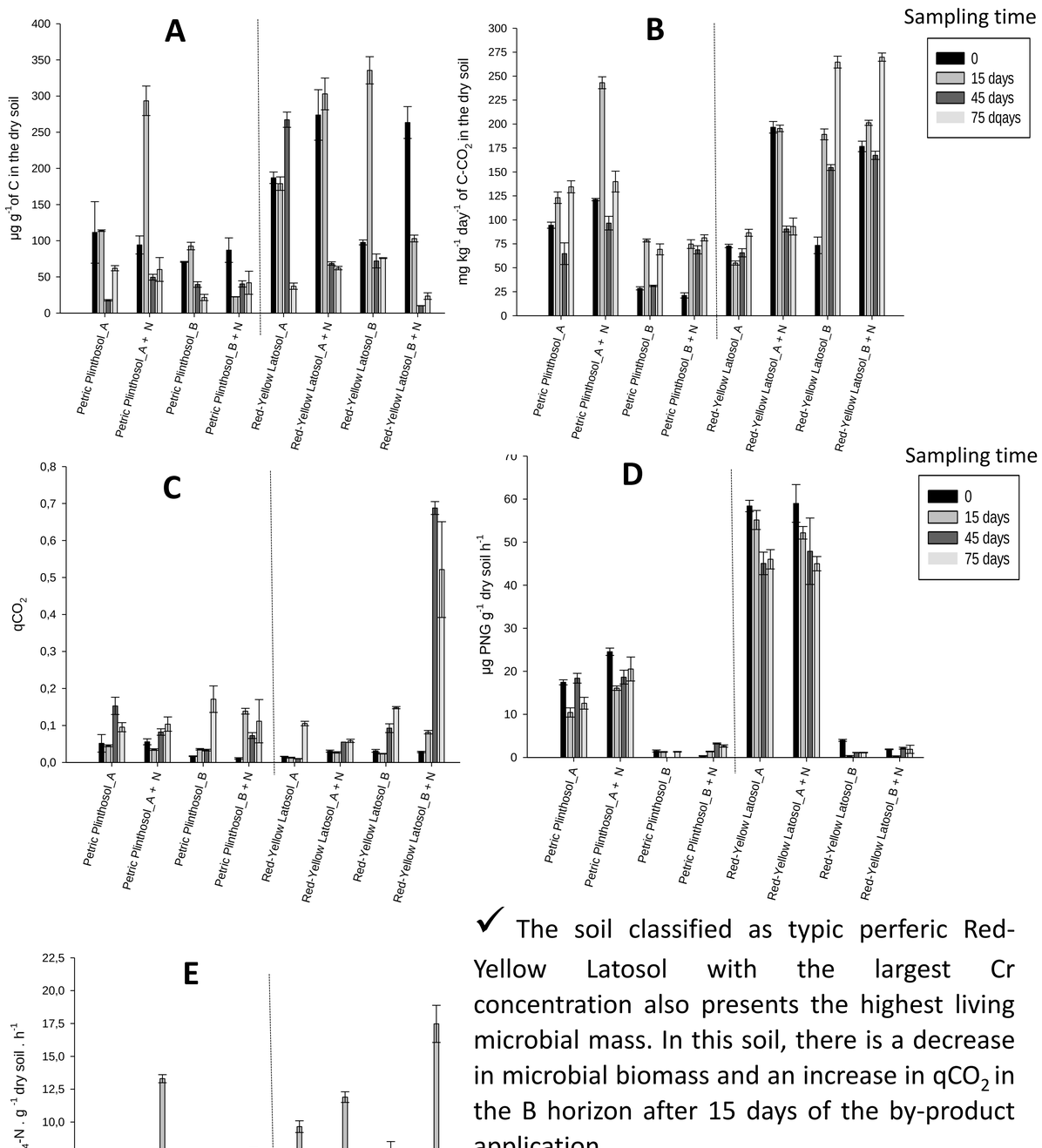


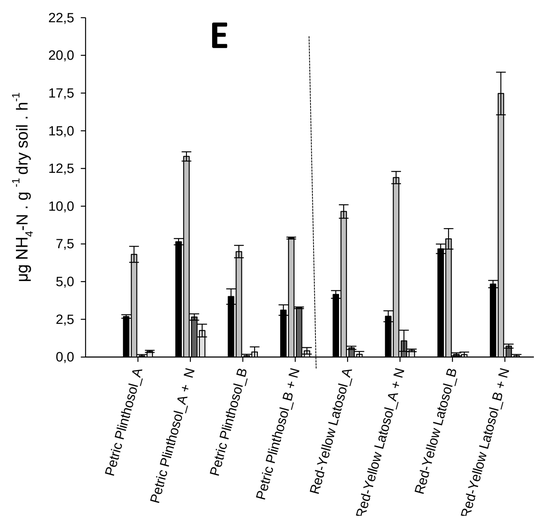


Urease activity



RESULTS





✓ The soil classified as typic perferic Red-Yellow Latosol with the largest Cr concentration also presents the highest living microbial mass. In this soil, there is a decrease in microbial biomass and an increase in qCO_2 in the B horizon after 15 days of the by-product application.

✓Higher concentrations of ß-glucosidase were detected in A horizons, regardless of the application of the by-product.

✓The Urease activity was larger at 15 days after application of the by-product from tannery industry, decreasing after 45 days.

FIGURE - A: Microbial biomass C (MBC), **B**: Soil basal respiration (SBR) **C**: metabolic quotient (qCO_2): ratio of SBR to MBC. **D:** β-glucosidase activity PNG= ρ-nitrophenol Glucoside **E:** Urease activity

CONCLUSIONS

✓ The by-product of the tannery industry seems to have had a positive effect on the biological attributes (MBC, SBR, and urease activity) due to the presence of N.

✓ Generally, the Cr content from by-product of the tannery industry does not alter the ecological equilibrium of the soil.

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