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Effect of a long-term afforestation of pine in a beech domain in NE-Spain revealed by analytical pyrolysis (Py-GC/MS)

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The replacement of native beech forests (Fagus sylvatica) by Scots pine (Pinus sylvestris) afforestation may exert changes in soil properties, particularly in soil organic matter (SOM) [1]. It is known that the products generated by Pyrolysis-gas chromatography/mass spectrometry (Py-GC/MS) pyrolysis of organic matter are related to their origin [2 and references therein]. Therefore this technique can be used to investigate said changes.

In this work, Py-GC/MS is used to study changes in SOM quality surrogated to the effect of the centennial replacement of beech by Scots pine. The soils studied were two acid soil profiles developed on quartzites under a humid climate at an altitude of 1400-1500 masl from Moncayo (Iberian range, NE-Spain). For each soil profile three organic layers (litter: OL, fragmented litter OF and humified litter OH) and the mineral soil horizons (Ah, E, Bhs and C) were sampled.

After 100 years since the pine afforestation, differences in the relative abundance of lipids released by pyrolysis were observed in the O-layers ranging from 3.82-7.20% in pine soils and 0.98-1.25% in beech soils. No differences were observed in mineral horizons with depth except for the C horizons where beech lipid content was much higher (21.25%) than in that under pine (1.07%).

Both pine and beech soils show similar nitrogen compounds relative contents along the soil profile, increasing from OL to Ah (3.49-9.11% and 2.75-11.73% in beech and pine respectively) with a conspicuous reduction in the E horizon. It is remarkable the absence of nitrogen compounds in beech Bhs and C horizons.

The relative content of aromatic compounds in O-layers show opposite trends for beech and pine; an enrichment in aromatic compounds is observed in beech OL layer (12.39%) decreasing to 4.11% in OH layer in contrast, whereas for pine O-layers the aromatic compounds relative abundance was higher in the OH (5.83%) than in the OL layer (2.8%). Mineral Ah and E horizons show similar values in both beech (18.30-10.09%) and pine (15.81-10.01%) soils; nevertheless the relative abundance of aromatic compounds content is higher in beech mineral horizons Bhs (41.96%) and C (30.91%) than in those under pine (11.43% and 13.04% for Bhs and C respectively).

Polycyclic aromatic hydrocarbons (PAHs) were only observed in the mineral soil horizons showing similar relative abundances ranging from 0.61-6.63% in beech and 0.96-3.05% in pine soils. The highest PAHs relative abundance was found in the Bhs horizon under beech. This may indicate the occurrence of fire events in the area and its translocation and accumulation by leaching from top soil in the spodic horizon.

Differences in the relative abundances of lignin derived pyrolysis products (Methoxyphenols) were mainly observed in the O-layers whereas the relative abundances were similar for the mineral horizons that ranged from 1.49-4.31% in beech and 1.42-4.67% in pine. Lignin relative abundance is much higher in OH beech layer (31.88%) than in pine OH layer (14.99%) whereas similar relative contents were found in OL and OF layers ranging from 26.21-27-12% and 20.22-25.92% in beech and pine respectively.

In the soil developed under beech the polysaccharide derived moieties show a relative content increase along the profile from a 9.86% in OL layer to a 29.86% in E horizon followed by a remarkable decrease in the Bhs (4.86%) and C (11.22%). Besides, the polysaccharide relative abundance in the soil under pine show a similar trend ranging from 12-23% to 30.65% but the decrease in Bhs and C horizons was found less marked (26.83%

and 24.12% respectively).

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