Influence of afforestation on soil : The case of mineral weathering

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Introduction

Planting fast growing trees on abandoned agricultural land (afforestation) is done all over the world as a means to satisfy increasing wood demand. However, similar to modern agriculture, increased nutrient uptake due to fast growth and nutrient export from harvest could lead to a decrease in soil nutrient availability and the increased use of fertilizer to maintain soil productivity. Recent research suggests that some tree species, notably late succession conifers, release acid exudates from their roots which attack the crystal lattice of minerals. This releases substantial amounts of base nutrients (Ca, Mg, K) which could sustain productivity over several rotations without fertilization. A sequential extraction/leaching procedure with diluted salt and weak acid solutions was therefore used to evaluate if available and structural base nutrients and other major cations (Na, Al, Fe) in soils were being depleted along a soil productivity (and age) gradient of hybrid *Populus*, a fast growing early succession deciduous tree genera used worldwide in an intensive plantation context, relative to abandoned agricultural fields.

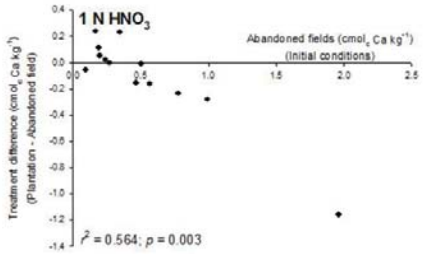

Figure 1. Relationship between abandoned fields and treatment difference for soil Ca following 1 N HNO_3 extraction.

Results and Conclusion

Soil structural Ca and Mg were lower under *Populus* at about half of the sites. The results suggest a greater capacity of the trees to promote soil mineral weathering than plants in abandoned fields. However, this ability appears to be linked to the initial chemical and mineralogical composition of the soils: the divergence between land use types was larger at sites with greater soil cation exchange capacity (more clay) and (or) structural Ca and Mg (more easily weathered Ca and Mg containing minerals) (Fig. 1). This means that fast growing *Populus* may only be capable of augmenting soil mineral weathering where soils are vulnerable to acid exudates. Hybrid *Populus* are not able to promote base nutrient release from minerals on coarse textured acidic soils where soil productivity is a real concern.

High-iron chamosite in bituminous coals in Xuanwei County, China: a possible contributing factor to a high lung cancer rate

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Certain communes in Xuanwei County, eastern Yunnan Province, have some of the highest rates of lung cancer mortality in China. Nationwide, age-adjusted mortality rates (per 100,000) are 6.8 and 3.2 for Chinese males and females, respectively [1]. With rates for Yunnan Province 4.3 and 1.5. In Xuanwei County, the rates are 27.7 for males and 25.3 for females and in the three communes with the highest mortality, the rates are males 118.0 and females 125.6 [1]. This exceptionally high rate and the similarity between the male and female rates is unusual as the females in this locality are essentially non-smokers. Previous workers attributed the high incidence of Xuanwei County lung cancer to domestic combustion of locally mined coal in houses with non-vented stoves [2]; however, this practice occurs in many Provinces without the effect of a high lung cancer rate. Generation of polycyclic aromatic hydrocarbons (PAHs) by coal combustion was first thought to be the disease etiology [1]. Additional work on coal mineralogy and combustion models suggested that small (<10 μm) to nanometer-sized quartz played a significant role in the disease etiology and that the combined influence of silica-volatile (PAHs) interaction was more hazardous and causal than either component alone [3].

We have examined 12 smoky bituminous coals from mines in communes with various degrees of age-adjusted lung cancer death rate as well as smokeless anthracite coals from mines southwest of Xuanwei City. We find no significant relationship between overall coal characteristics and the lung cancer rate with the exception of the iron content of the coal (expressed as Fe_2O_3 on an ash-basis). The abundance of very iron-rich chamosite [(Fe/(Fe+Mg)) > 0.85] is the source of this iron enrichment (iron sulfides and oxides are rare).

Although iron is critical for normal cell function, because of its ability to reduce oxygen, iron is the most potent inducer of free radicals in most biological systems. Recent work on the cause of coal workers' pneumoconiosis suggests a strong correlation with the bioavailable iron content of coal [4]. We suggest that during domestic coal combustion, chamosite is thermally decomposed and may supply minute iron oxides to the coal smoke. Although our statistical basis is small (n = 12) the presence of this high-iron phase may add to the combined influence of PAHs and silica and should be considered as a potential contributing factor to the high lung cancer rate.

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