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Progressing from Terra Preta de Índios to the Whole World

Soil characteristics of a half century old Terra Preta in Sweden

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Introduction

Sweden has a long history of char production. For more than thousand years, char has been used for iron production in Sweden and during World War II; wood was gasified and used to run vehicles. At some places, it was noted that char improved plant growth.

Here we present an investigation of a unique Swedish terra preta. The area is a piece of farmland situated outside Uppsala, which inhabited charcoal kilns for about a decade seventy years ago[1]. Due to residues from the kilns an area of 520 m^2 holds high concentrations of charcoal. Interestingly, adjacent to the terra preta there is an area without coal but otherwise with the same soil and with the same history of cultivation. Here we present comparing analyses of crop yield and physical soil characteristics such as density, organic content and water holding capacity from both areas. The common soil is a clay soil with a high content of organic matter and the soil is highly fertile also in its original state.

Results and Discussions

Sampling.

Two samples from the terra preta (TP1 and TP2) and two samples from the area without coal (original soil, OS1 and OS2) were taken. TP1 was close to the site were the kilns had been. Furthermore, one sample was prepared by mixing an OS-sample with charcoal (TP ref) and one by stirring an OS-sample similar to the TP ref case (OS ref).

Bulk density of dried soil.2

Samples from the terra preta area had bulk densities of 0.9 (TP1) and 1.0 (TP2) while the corresponding values from the non carbon area were 1.8 (OS1) and 1.5 (OS2). Thus, the terra preta had about 40% lower bulk density.

Soil grain size distribution.2,3

Samples heated at 600 °C were sieved and the different fractions were weighted. The result in figure 1 shows that the charcoal containing samples have a higher content of coarse grains and that the samples with the highest content of charcoal also have most coarse grains. The explanation is that the heat from the kilns sintered clay into larger particles.

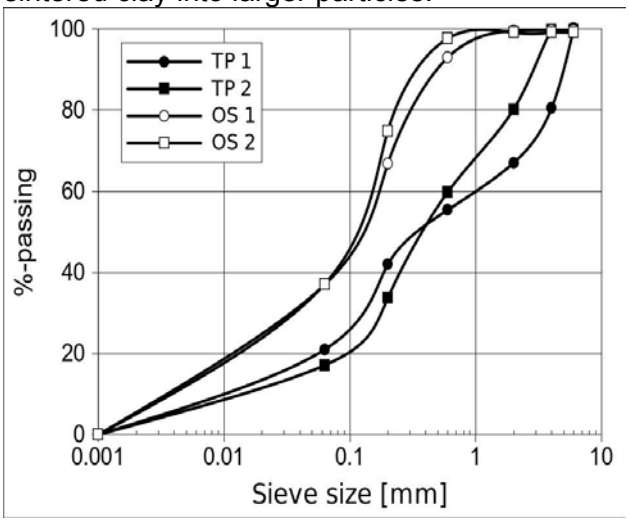

Figure 1. Soil grain size distribution.

Content of organically derived carbon matter[2]

Dried samples were weighted before and after being heated at 550 °C. Samples from the terra preta area had weight losses of 37(TP1) and 31% (TP2) while the corresponding values from the non carbon area were 9 (OS1) and 10% (OS2). Thus, the terra preta had about 25 percent units more combustible matter, which should approximately equal the content of organically derived carbon matter.

Water quota[2]

The proportions of natural water (moisture present at the sampling) were calculated. Samples from the terra preta area had quotas of 65 (TP1) and 42 (TP2) while the corresponding values from the non carbon area were 20 (OS1) and 22 (OS2).Thus, the water

quotas in the terra preta were in average about 150% higher.

Water retention.

This analysis describes the capacity of a soil to hold water and the amount of the water that is accessible to plants (Fig 2).

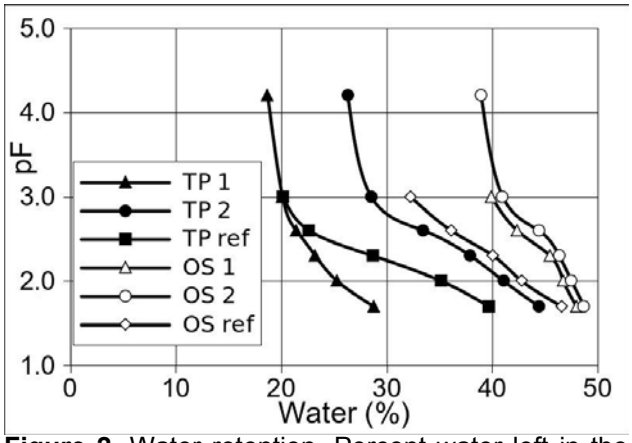

Figure 2. Water retention. Percent water left in the soil at different pressures (pF is the negative logarithmic value of drainage suction pressure expressed as cm water column). The analysis was performed at University of Copenhagen, Faculty of Life Sciences, Denmark, by Dr Carsten Pedersen.

The numbers in Table 1 was calculated using data from Figure 2. The accessible water in TP2 was about 100% higher than the values for OS, but the value for TP1, that had the highest content of combustible matter, was similar to the OS values. The reason is probable the higher content of coarse grains in TP1 (as can be seen in figure 1), that evens out the water retaining properties of the charcoal.

Table 1. Accessible water

Sample	Accessible water %
TP1	8.6
TP2	15.9
OS1	8.1
OS2	7.7
TPR*	19.5
OSR*	14.3

* TPR: terra preta reference. OSR: original soil reference.

Crop yield.

At the time of investigation, a mixture of oats and barley was grown. Plant samples of 17 one-meter long strings were taken from arbitrary selected positions at crop maturation.

The samples were dried and the total amount of above ground plant material was weighted. The crop yield analysis showed that there was no difference between the terra preta and the adjacent original area (at the 90% significance level). It should be noted however, that the variation within each group was large. It is also possible that the concomitant sintered clay evened out the positive effect that charcoal could have, via increased water retaining capacity, on crop yield.

A more elaborated crop sampling procedure is required in order to determine if there is a substantial and significant difference between the TP and OS areas with regard to crop yield.

Table 2. Crop yield statistics

	TP	OS
Crop yield mean value[a]	154	148
Standard deviation[a]	33	21
Variance coefficient[b]	21	14

[a] g.[b].%.

Conclusions

The charcoal containing soil had lower density and higher water quota. The water accessibility for plants was elevated in the *terra preta* area but not where the highest concentration of charcoal was found. This was probably due to increased content of more coarse soil particles originating from sintering processes of the clay soil. The crop yield analysis did not show a significant difference between the *terra preta* and the adjacent original area.

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