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Master Thesis

The Potential of Pioneer Management Systems to Improve Soil Organic Carbon

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Affirmation

I declare in lieu of an oath that I have written this thesis autonomously, that I have not used any aids other than those indicated and that I have cited all formulations and concepts taken from unprinted sources, printed literature or from the Internet in their wording or essential content in accordance with the guidelines for academic papers and indicated them with a precise reference to the source.

Acknowledgement

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Abstract

The recent IPCC report depicts the urgent need to cope with climate change. With uncertainties regarding our livelihoods driven by the consequences of climate change, the natural carbon cycle gains unprecedented importance. The soil and more precisely the contained organic matter are the second-largest active carbon stock, which makes it the largest terrestrial system. To elucidate the potential carbon sinks of terrestrial ecosystems is therefore of crucial importance for mitigating anthropogenic driven climate change via carbon sequestration. Thus there is a need for a better understanding of how agricultural practices could increase soil organic carbon (SOC) content. An international initiative worth being mentioned at this point, is the so called „4 per 1000“, addressing climate change and food security simultaneously through appropriate management of soils. The present thesis aims to compare SOC quantity among three different systems (conventional agricultural land, pioneer management land, and grassland as a reference soil) to a total depth of 35cm in three intervals and twenty-one sites. Different soil parameters are analyzed, such as the pH value and the electrical conductivity, carbonate content, as well as the dissolved organic carbon and the carbon to nitrogen ratio is being determined. On average, the pioneer management system soils contain 20% more SOC and 29.17% more DOC than the standard management system soils. Both agricultural systems were still far away from the values observed in the reference systems. This trend was found for nearly all parameters, namely reference systems showing the highest values, followed by the pioneer systems which are higher than the standard system. There are also a strong relationship between SOC and aggregate stability, which suggests that the stability of the soil is important for the build-up of SOC. To summarize, pioneer farming management has a great potential to increase SOC storage in soils of North-East-Austria.

Zusammenfassung

Der jüngste IPCC Report betont die Dringlichkeit Maßnahmen gegen den anthropogenen Klimawandel anzuwenden. Der natürliche Kohlenstoffkreislauf bekommt daher neue Wichtigkeit für die Existenzgrundlage vieler Menschen. Der Boden und darin enthaltenen Organische Masse sind der zweitgrößte aktive Kohlenstoffspeicher unseres Planeten und die größte terrestrische Kohlenstoffsänke. Speziell hinsichtlich Landwirtschaftlicher Praktiken und deren Einfluss auf die Kohlenstoffspeicherung im Boden ist daher ein enormer Forschungsbedarf, letztendlich um den organischen Kohlenstoff (SOC) im Boden zu erhöhen. Eine internationale Initiative, die an dieser Stelle genannt werden darf, ist die „4 per 1000“, welche versucht mittels angepasstem Landwirtschaftlichem Management die Nahrungssicherheit unter den Einflüssen vom Klimawandel sicherzustellen. Diese Arbeit vergleicht den Kohlenstoffgehalt und weitere Parameter der Bodenqualität betreffend, drei verschiedener Landwirtschaftlicher Systeme (pioneer, standard und reference) bis zu einer Tiefe von 35 cm an über 21 Standorten. Dies um die Fragestellung, ob durch die Anwendung angepasster landwirtschaftlicher Maßnahmen der SOC Gehalt im Boden im Vergleich zu einem standard system erhöht werden kann, und ob dadurch sogar der eines natürlichen reference system imitiert werden kann, zu beantworten. Es werden Korrelationen zwischen diesen Parametern und dem SOC analysiert, um zu verstehen welche die größte Auswirkung auf den SOC im Boden haben. Zusammenfassend kann beobachtet werden, dass die Böden der pioneer systems im Mittel 20% mehr SOC und 29,17% mehr DOC enthalten als die Böden der standard systems. Dieser Trend wurde für fast alle Parameter festgestellt, nämlich dass reference die höchsten Werte aufwies, gefolgt von den pioneer, die im Vergleich zum standard höher waren. Zusammenfassend lässt sich sagen, dass Pionierlandwirtschaft ein großes Potenzial zur Erhöhung der SOC Speicherung in Böden Niederösterreichs hat.

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List of acronyms

SOC	Soil organic carbon
SOM	Soil organic matter
POM	Particulate organic matter
MAOM	Mineral associated organic matter
C	Carbon
DOC	Dissolved organic carbon
N	Nitrogen
GHG	Greenhouse gas
NPP	Net primary production
GPP	Gross primary production
O	Oxygen
CEC	Cation exchange capacity
OM	Organic matter
ppm	Parts per million
ppb	Parts per billion
Pg	Peta gram
AFOLU	Agriculture, forestry, and other land uses
CF	Carbon footprint
Ca ⁺⁺	Calcium ion
a	Year, usually referring to: per year

1 Introduction

The following section provides an introduction to the topic of soil organic carbon (SOC). Further some of the general questions e.g., on how the carbon (C) gets into the soil in the first place, why it is so relevant in terms of climate change and lastly, its importance for the soil's soundness will be responded to. Starting with the role of C in the atmosphere and its relevance regarding anthropogenic emissions and thus the effect on climate change, continuing with how the C gets accumulated in biomass and finishing with the way C gets into soils and its importance for fauna and flora.

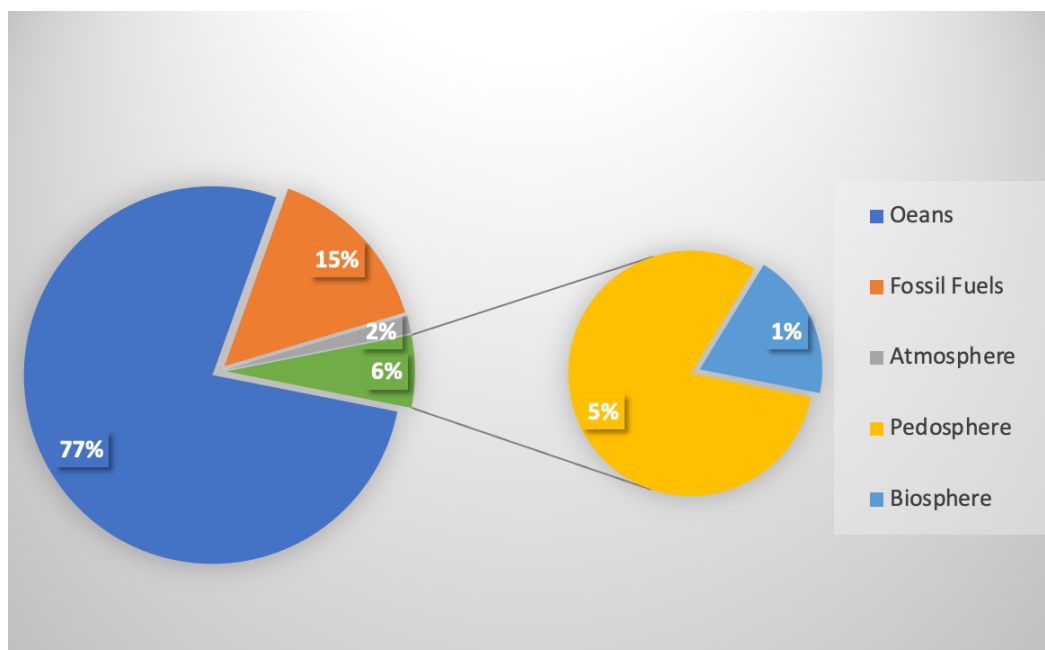


Figure 1: This pie chart illustrates the different shares of the carbon pools from the total carbon present on planet Earth. The 6% subdivided into Pedosphere and Biosphere are the total carbon present in the terrestrial system. As can be seen, the oceans are the biggest pool, and the atmosphere is the smallest.

The total amount of 50,400 Pg of C present on Earth split between the different biospheres can be fragmented as follows. Although it might be tough to find the appropriate boundaries between one sphere or pool and the other, as they are all interconnected and so constituting the global C cycle, a division has been established. As can be seen in Figure 1, the oceans are the largest C pool and therefore making up about 77.4% of the total C, followed by fossil fuels, containing about 14.9% of the C, the terrestrial pool representing 6.2%, further divided in the pedogenic pool (5%) and the biotic pool (1.2%) and lastly the atmosphere, in fact containing the least amount of C, namely only about 1.5% of the total C present on the planet. Even though

numbers regarding C contents in the different pools vary within literature, one thing is clear: the atmosphere represents the smallest C pool amongst the spheres. Exactly because of the atmosphere being a comparatively small C pool, anthropogenic greenhouse gas (GHG) emissions have such a huge impact on it and thus climate change is dramatically driven by human activities (France, Willem, Friedlingstein, & Munhoven, 2013; Rattan Lal, 2010; Petrokofsky et al., 2012).

1.1 Introduction Atmosphere

The current concentration of carbon dioxide (CO_2) in the atmosphere is 419.85 ppm, as of May 2021, and the annual increase for the last period has been measured to be 2.92 ppm. Secondly, the concentration of methane (CH_4) as of January 2021 is at a record high of 1,893.4 ppb and last had a mean annual growth rate of 16 ppb, this is depicted in Figure 2 (Dlugokencky, 2021). With the constantly increasing CO_2 and CH_4 concentrations in our atmosphere, the negative effects of climate change become progressively more noticeable and have an increasingly greater impact on both, our environment and livelihood (de Vrese, Stacke, Kleinen, & Brovkin, 2020; Hope, 2006; R. Lal, 2008; Liu et al., 2017; Stern, 2013). The average atmospheric carbon increase, also called the CO_2 growth rate, is a flux calculated from averaged anthropogenic emissions. According to France et al. (2013), this value amounted to averaged 4 Pg C/a for the period from 2000-2009. In total an estimated sum of 250 Pg C was gained by the atmospheric C stock since prior to the industrial revolution era, about 1750 (France et al., 2013). The current total amount of CO_2 present in the atmosphere is estimated to be approximately 710 Pg C. Thus, solutions to mitigate anthropogenic GHG emissions are desperately sought after and the idea of reducing the consequences of climate change is adhered in international agreements (Maizland, 2021; Wigley, 1989). Hence, carbon stocks and fluxes present in the Earth's ecosystems and natural cycles become a relevant topic for scientific research, in order to provide a solid base upon which policymakers may take the much-needed right decisions.

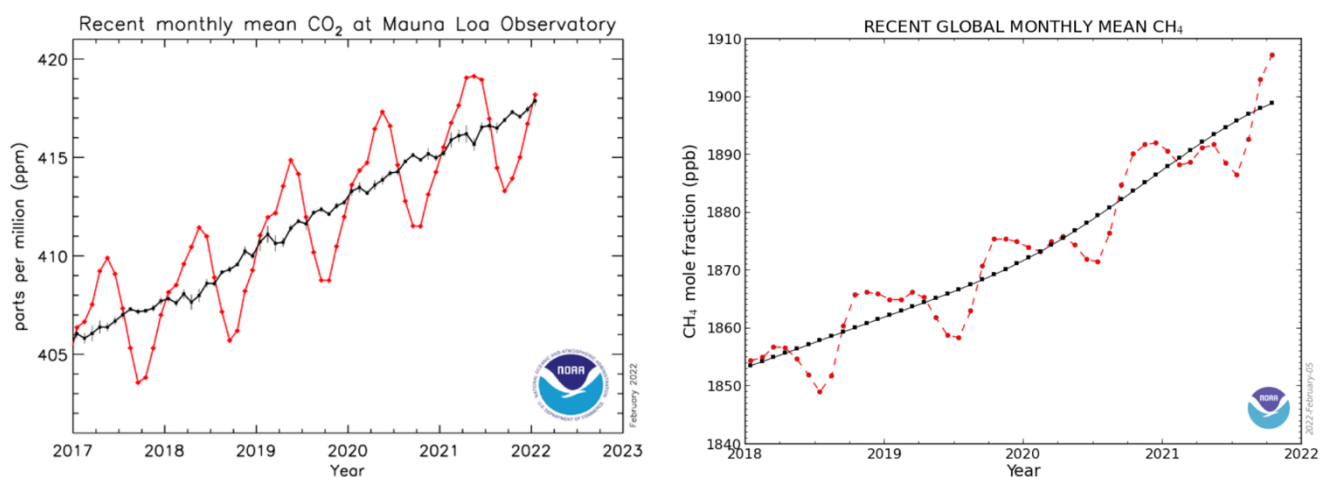


Figure 2: Two graphs depicting the measured concentrations of CO_2 (in the left) and CH_4 (in the right) in the atmosphere over the course of the past years and their smoothened trend. In these two figures, the red lines are globally averaged monthly mean values. The black lines show the long-term trend where the average seasonal cycle has been removed. Adopted from: Ed Dlugokencky, NOAA/GML (gml.noaa.gov/ccgg/trends_ch4/).

1.2 Introduction Biosphere

The process of photosynthesis transforms water (H_2O), taken up by roots from the soil and CO_2 , taken up from the atmosphere through stoma in the leaves, into carbohydrates and oxygen (O) with sunlight as the energy source for this chemical reaction. These organic molecules are then used by the plant for the buildup of biomass or stored as fuel for metabolic activities of the organism. On a bigger scale this phenomenon is called gross primary production (GPP) and is a major global C sequestration mechanism. If the respiration i.e., the organic matter (OM) primarily released in form of CO_2 is subtracted from the GPP, the net primary production (NPP) is gained as the result, which represents the C sink capacity of photosynthesis. As biomass consists of about 50% C, pools of deadwood and litter could be as large as the above ground biomass. In order to calculate C losses from biomass through decomposition, deadwood pools such as fallen woody debris, standing dead trees, and decaying and burnt wood are of high interest (Petrokofsky et al., 2012). According to Lal (2010) the biosphere, or biotic pool as referred to, consists of 560 Pg C live biomass and 60 Pg C detritus material (Rattan Lal, 2010). The process of transferring CO_2 from the atmosphere into biomass through GPP, and therefore sequestering the C in the biosphere, at least temporarily, is called carbonization. However, the part of the C sequestration through NPP succeeding long-term, is the so-called terrestrial sequestration. That part represents the formation of stable OC fractions in the soil, which will persist for centuries and perhaps even millennia, strongly depending on the soil type and the site characteristics (Dynarski, Bossio, & Scow, 2020). A schematic representation of the ratio

between above- and below-ground phytomass of different climate zones can be seen in Figure 3.

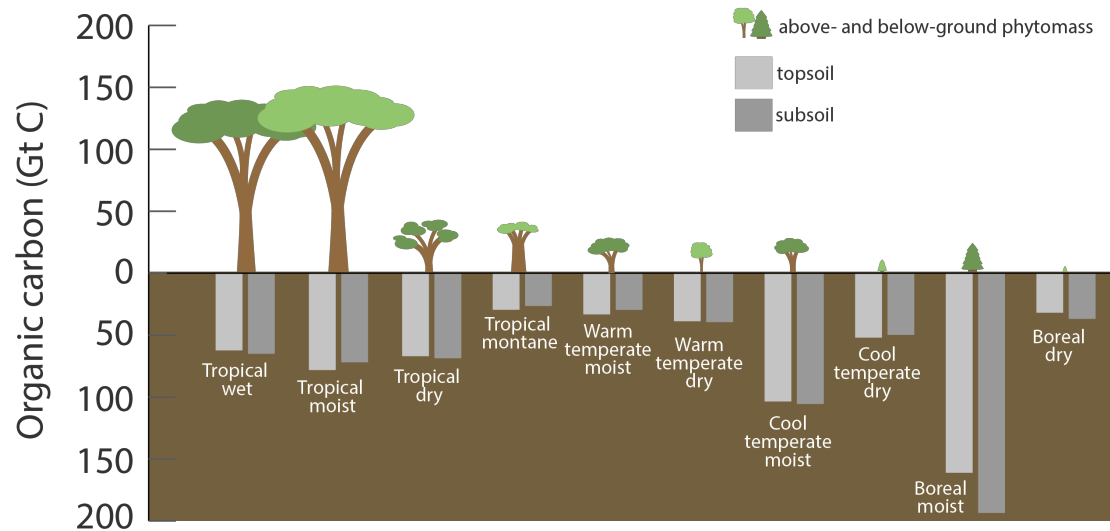


Figure 3: Organic carbon stocks of the terrestrial biomass are subdivided in the different IPCC climate regions and in above- and below-ground phytomass and topsoil (light grey) and subsoil (dark grey) fractions. On the ordinate axis the approximated value of organic carbon of the different pools and regions is shown in Gt (equals to Pg). This graph further shows the linkage between the above phytomass, the below biomass and the influence of the climate region on the long-term storage of organic carbon in soils. Taken from Kayler et al., 2017.

1.3 Introduction Pedosphere

Soils represent the largest terrestrial C pool, globally containing roughly 1,500 Pg of organic carbon (OC) within the first meter of depth and an astonishing 2,000 Pg C up to 2 m of depth. According to Lal (2010) the pedosphere up to 1 m depth even contains an astounding 2,500 Pg of C, consisting of 1,550 Pg OC and 950 Pg of inorganic C (Rattan Lal, 2010). Whereas the total global vegetation and the atmosphere only contain approximately 610 Pg and 750 Pg of OC respectively (Petrokofsky et al., 2012). Since there are considerable differences in the numbers found in literature regarding the global SOC stock Scharlemann et al. (2014) consulted a total of 27 studies and found the median to be 1,460.5 Pg of C, given values ranged from 504 to 3,000. The C stock stored in soils is simply put a balance between the organic input (dead plant material or animal tissue) and C loss due to decomposition and mineralization of that organic matter, which is referred to as the heterotrophic respiration. The biggest anthropogenic influences on the diminution of the C stock in soils are land use and land cover change

(LULCC) and the extraction and the successive combustion of fossil fuels, thus emitting critical amounts of CO_2 which up to this point were sequestered and stored for thousands or even millions of years. According to Schrlemann et al. (2014) there are three main factors underlying the effects of LULCC: the sheer quantity present in the phytomass and soils affected, the spatial distribution of those C stocks and the influence of land management measures on these. The last point, is exactly the key question to the research conducted for this work (Scharlemann, Tanner, Hiederer, & Kapos, 2014).

Coming back to the natural C cycle influencing the soil and its C stock, it should be mentioned that, roots have the ability to perform autotrophic respiration and together with the heterotrophic one it is simply named the soil respiration or the soil CO_2 efflux. However, if aerobic conditions are given, most of the C getting into the soil through accumulation of organic matter, returns back into the atmosphere and the C cycle between atmosphere, biosphere and pedosphere comes full circle at this point (Petrokofsky et al., 2012). The mineralization rate of a soil is a function of the specific site factors, such as moisture content and temperature and reigning chemical factors, including pH, CEC and EC (Petrokofsky et al., 2012). Summarizing it can be said, that soil organic carbon (SOC) is the largest carbon pool in the terrestrial biosphere (Zeng, Wei, Huang, Chen, & Cai, 2021). This is the exact reason why the IPCC and EU CAP suggest agricultural practices to enhance the carbon content in soils or at least diminish the loss of carbon from soils through their regulations.

The idea behind this research project, is that the global C sinks, may be filled up again through enhanced NPP and subsequent terrestrial sequestration in soils, as they have been depleted in C since the first settlers starting farming thousands of years ago. In total the soils have a huge long-term potential of binding stable OC, as biomass does have too, with the only difference that it is rather short-term, compared to other pools, such as the ocean or in fact the pedosphere. Agricultural practices in cropping have an important role regarding the sequestration of C through the NPP in the biomass and subsequently in the pedosphere, through terrestrial sequestration of transformation of OM by soil fauna and chemical reactions. The following example shall give an overview of the CO_2 balance in such a crop system. A field of corn (*Zea mays* L.) gains approximately $5 \text{ t C/ha} \cdot \text{a}$ (tons of C per hectare and year) bound in biomass (such as stover, roots, grains etc.), whereas the release of CO_2 in the atmosphere above that field is estimated to be only $0,0125 \text{ t}$ of C per year. Another valid comparison is the directly measured CO_2 emissions from maize grain fields, depending on the literature ranging from $2,440 \text{ kg } CO_2 \text{ eq.}$ to $4,200 \text{ kg } CO_2 \text{ eq.}$ Also, strongly depending on the farm management regarding tillage activities. Translated in lean C masses, that carbon footprint (CF) would be ranging from

915 $\text{kgC/ha}\cdot\text{a}$ to 1,575 $\text{kgC/ha}\cdot\text{a}$. Compared to the before mentioned C gain of 5,000 $\text{kgC/ha}\cdot\text{a}$ there is still a huge net increase in biomass sequestered C of crop fields, such as maize for this specific example (Camargo, Ryan, & Richard, 2013; Holka & Bienkowski, 2020; R. Lal, 1997). According to the IPCC (2007) 30% of the total anthropogenic greenhouse gas (GHG) emissions have their origin in agriculture, forestry and other land uses (AFOLU). Whereat agriculture is responsible for more than 60% of the N_2O and 50% of the CH_4 emissions. However, deforestation and land use change represent the two biggest sources CO_2 emissions within the realm of AFOLU. Further it is known that the processes interconnecting the emissions of aforementioned GHG are particularly complex in cropping and grazing systems. On the other hand, agriculture is recognized to have the potential of major C sink. In accordance with calculations made by the IPCC, agriculture has a potential of mitigating between 5.5 and 6 $\text{PgCO}_2\text{eq/a}$. As a result, it becomes clear, that there is a need of assessing the C content in soils as accurately as possible, in order to monitor and comply with possible future guidelines or even implemented policies (Petrokofsky et al., 2012).

Following Cotrufo (2020) there are two strategies to manage SOM stocks in order to enhance global C mitigation: sequestration versus functioning. Most research about mitigation of atmospheric C concentrates on sequestration and long-term storing of OC. On the other hand, there is the less talked about strategy of enhancing the soils fertility, which in turn requires SOM in a quality that can be accessed easily by soil biota. Concluding, Cotrufo (2020) notes, that generally “any efforts to address global change challenges via SOM will benefit from larger SOM stocks”. In Table 1 a list of the C contents in Pg subdivided into top- and subsoil C of the different climate zones is shown. As can be seen the boreal moist IPCC climate zone is the one containing the most C, as featuring the most favorable conditions for long term storage of OM and thus SOC: comparatively cold and moist.

Table 1: In this table the amount of C is listed in Pg for each climate zone. The C is subdivided into topsoil, subsoil and summarized as total C present in the soil of the individual climate zone. The climate zone classification is taken from the IPCC. Data taken from Scharlemann et al, 2014.

<i>IPCC climate zones</i>	<i>Topsoil (Pg C)</i>	<i>Subsoil (Pg C)</i>	<i>Total (Pg C)</i>
<i>Tropical wet</i>	62.2	65.4	128
<i>Tropical moist</i>	78.6	72.3	150.9
<i>Tropical dry</i>	67.3	69	136.2
<i>Tropical montane</i>	29.6	26.5	56.1
<i>Warm temperate moist</i>	33.3	29.7	63
<i>Warm temperate dry</i>	38.9	39.6	78.5
<i>Cool temperate moist</i>	104.1	106.2	210.3
<i>Cool temperate dry</i>	52.2	50	102.2
<i>Boreal moist</i>	162	194.7	356.7
<i>Boreal dry</i>	32	37	69
<i>Polar moist</i>	30.6	21.7	52.3
<i>Polar dry</i>	8	4.3	12.3
<i>Total</i>	699.3	716.4	1,415.7

2 Literature Review

In the following chapter and its subchapters an overview of the historic and nowadays outdated models regarding OM and especially OC is given. After that the current models and theories are briefly described and compared.

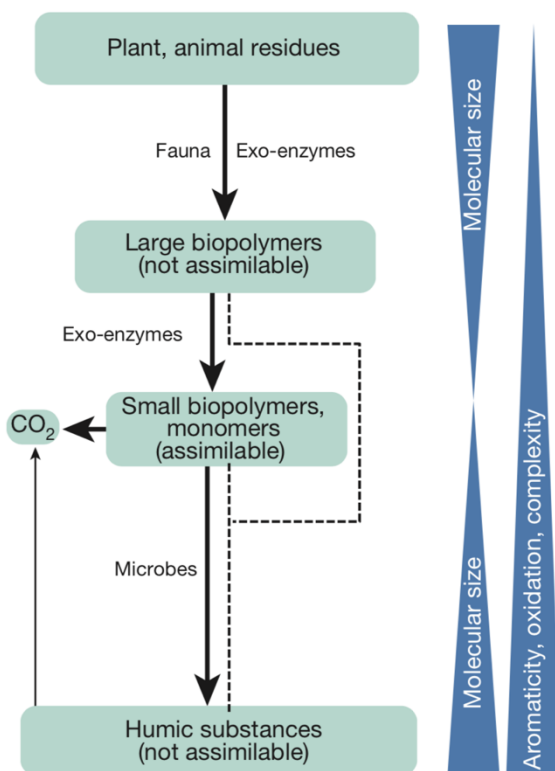
2.1 Historical View on Soil Organic Carbon

In the 1970ies a paradigm regarding soil organic matter (SOM) dynamics has been established by soil science, based on the solubility and chemical recalcitrance, so the to date well-known and widely used terms humin, humic and fulvic acids have been introduced to the world. At the time a rather simple one-pool-model has been created to estimate soil organic carbon (SOC) content and fluxes in soils. Other ideas quickly arose the next decade, stability and turn over were the keywords to describe SOM back then. Physical properties, such as size and density were then used to group and categorize carbon types presents in soils into pools and separate them. In theory the current paradigm does not differ greatly from the ones afore mentioned, as the main strategy remains to divide SOC into pools whit different turn over times or separate aggregates through physical properties (Blankinship et al., 2018).

Early scientific methods for analyzing SOM involved chemical separation of present organic forms by alkaline extraction, leading to the detection and recognition of the study of humic substances in the soil science realm. On the other hand, the mentioned forms of SOM, have already been seen as artificial by-products as early as in the 1840ies. Therefor not coinciding with the naturally occurring SOM components, which ultimately lead to the dismissal of humic substance as proxy for SOM in the soil science community. Consequently, physical properties such as size and density were used for separating characteristics. As a result, a SOM subdivision with highly contrasting forms, showing differences in turn-over rates and general properties, was discovered. Particulate organic matter (POM) and mineral associated organic matter (MAOM) are two of the up to 4 groups established since then. A plurality of physical and chemical methods found their use in the research of SOM, often tailored to very specific scientific questions, ecosystems or areas. Great knowledge was accumulated during the following decades, whereas all of these newly introduced ideas and explanations ultimately lead to disorientation regarding the nature of SOM and its components (Lavallee, Soong, & Cotrufo, 2020).

In the past SOM was often linked to dark colored and big-sized molecules. Before the availability of spectroscopic methods, a chemical separation of the mineral and organic phase of the soil particles was needed. This separation was achieved through alkaline extraction

method, known as having been used since 1786, however resulting in artificial products of the process itself. Although the extraction method was criticized as incomplete and selective in 1888, these doubts were quickly dismissed it evolved to a widely used and well accepted method for determining SOM. Up to this day, there has not been independent evidence of humic substances separately existing in the soil environment. Now it is not utterly clear what the term humic substances refers to, as there have been plenty of alternative definitions, depending on the field of study or geographical location the research has been conducted (Lehmann & Kleber, 2015).



Humification describes the processes involved in the stabilization of organic matter, associated with the outdated humic substance model. Accordingly, plant and animal residues are decomposed into not-assimilable large biopolymers mainly by soil fauna and enzymes. These are then further decomposed into smaller biopolymers and monomers, again with the help of exo-enzymes, but this time assimilable. Additionally, CO_2 forms through respiration during this step. These molecules are further synthesized to larger and dark-colored compounds, falsely known as humic substances, by microbes, which once again become not assimilable and thus stable. (Lehmann & Kleber, 2015). The above mentioned outdated model is

Figure 4: Representation of the classic “Humification Model”, that mainly relies on the decomposition of organic material input through soil macro biota and enzymes. The so produced biopolymers are successively built up again and aggregated to synthesized humic substance. Taken from Lehmann & Kleber, 2015.

schematically represented in Figure 4.

Due to the widely accepted humification model, as represented in fig. 4, some more assumptions about the nature of SOM were made. The quality of OM was for instance thought to be responsible for the quantity of CO_2 emissions, additionally the existence of stable “humus” in natural ecosystems was taken for granted. Another interesting and rather specific assumption was, that humic substances containing old-aged carbon, identified through the radiocarbon dating method, are more recalcitrant. Today the specific age of the carbon is not

seen as a valid criterion for the recalcitrance of SOM anymore, by the scientific community (Lehmann & Kleber, 2015).

2.2 New Models: Continuum Model etc.

Over the past decades, the community around soil sciences experienced a change regarding how SOC is recognized, analyzed, and ultimately defined. Some authors in recent literature would even call it a paradigm shift. However, this acknowledgment has not happened overnight, it was rather a longer-term process forming different theories and models around SOC, its origin, its disposition, and especially its reciprocity with the biotic and abiotic soil environment. On the other hand, more than enough representatives of the old school humic substance theory, as explained in the previous chapter, are left in the scientific community yet. Nevertheless, as it is known in the realm of climate change studies as well, it is not ultimate proof of a certain coherence that makes it acceptable for scientific use but rather the broad consensus among experts that enables theories to become rightful. The following chapter will describe a few selected up-to-date and approved theories and models describing the properties and constituents of SOC.

2.2.1 Dynamic Stability

The term persistence refers to the longevity of SOC, which depends on the biological, physiochemical and environmental factors influencing the SOM decomposition. The rhizosphere and the detritus-sphere are found to be preferential congregations for microbes as they tend to concentrate on specific nutrient rich environments. This phenomenon and the fact that micropore development further increases the resource heterogeneity in soils, along the usual parameters influencing SOM decomposition, such as moisture, temperature redox potential etc. lead to the physical isolation of microbes from SOM. Further, these factors together with limited pore connectivity constrain the ability of microbial populations to decompose SOM even if having access. Direct observation of recently conducted studies suggests, that the soil pore network and especially its heterogeneity is an important parameter regarding the stabilization of SOM. Moreover, it has been posited that the mineral interactions with the SOM do not provide a durable protection from decomposition but rather slow down its flow through the soil matrix. All these findings lead to the idea of a dynamic stability of SOM and therefore SOC, allowing the possibility of MAOM de-sorbing and re-entering the soil solution as DOC. Following it can be transported further down the soil matrix and may be repeatedly consumed by microbes in order to eventually be re-sorbed onto mineral surfaces

(Dynarski et al., 2020). The idea behind the dynamic stability is broken down in Figure 5. Recapitulatory a few key findings within the dynamic stability theory can be stated:

- 1) Interactions between SOM and soil minerals are temporary
- 2) SOM persistence is mainly influenced by its flow through the heterogenous soil matrix
- 3) For the stabilization necessary isolation of SOM from microbes is predominantly found at a soil depth below 30 cm
- 4) At these depths 90% of the SOM is MAOM fraction and is thus less accessible to microbial populations
- 5) The deep soil simultaneously constrains microbial metabolism and therefore limits free POM decomposition and extends its residence time
- 6) Hence significant amounts of aged SOC can be accumulated in deeper soil, despite generally disposing of less SOM than the topsoil (Dynarski et al., 2020)

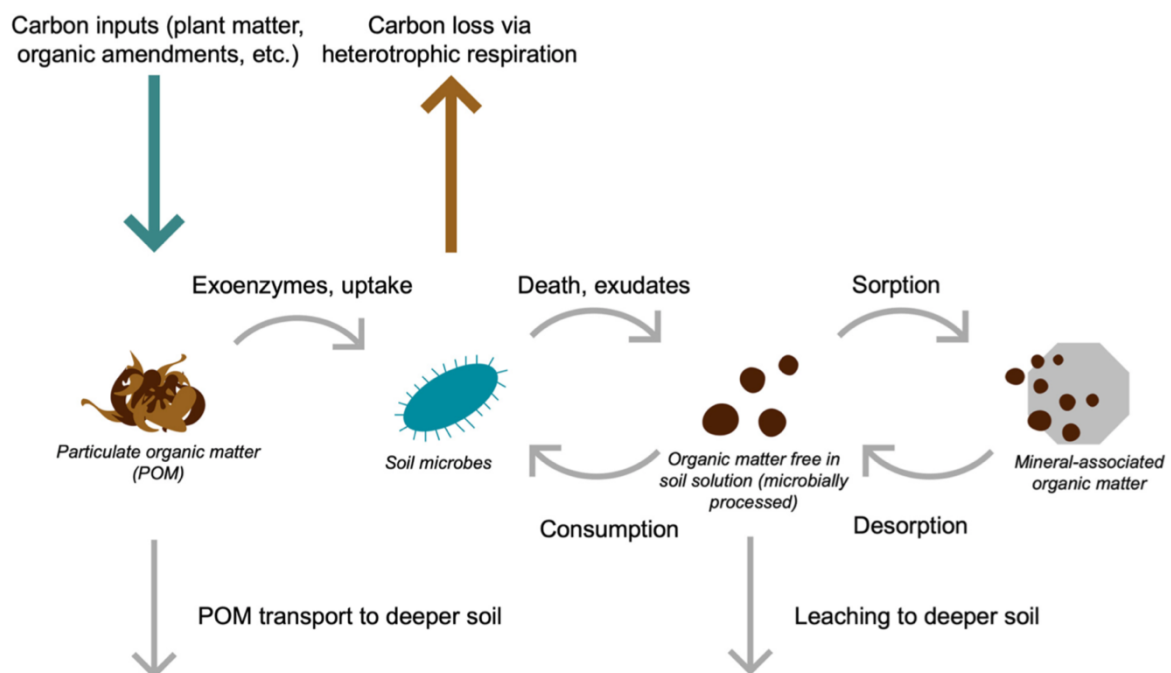


Figure 5: Emphasizing the importance of the C flows rather than stocks, this figure depicts the relation between the key players in the soil when it comes to the dynamic stability of C and its different forms. Each state of C is temporary, and they are all interconnected through the life and death of soil microbes and the chemical reactions of abiotic soil components. Taken from Dynarski et al., 2020.

2.2.2 Selective Preservation, progressive decomposition and consolidated view (soil continuum model)

According to the concept of selective preservation, SOM consists of a labile and a recalcitrant compound pool. The latter is only used for consumption by microbes in case the former one is not available, meaning that one fraction is preferably consumed, leaving the more stable fraction in the soil for extended periods of time. Furthermore, small organic molecules are needed by microbes as energy source for the decomposition and mineralization of the more recalcitrant compounds.

The progressive decomposition model suggests that SOM is made up of organic molecules in a variety of different sizes and decomposition stages. The molecular size is progressively decreasing throughout the decomposition processes and the oxidation is increasing. Starting with relatively big and intact plant and animal residues, large polymers are formed with the help of exo-enzymes, then small polymers, which are now assimilable and are broken down further into monomers by microbes until eventually all is mineralized and only the CO_2 is left. Out of the two above mentioned concepts, the consolidated view emerged: the so-called soil continuum model. It is comprised of two main ideas, the first one being similar to the progressive decomposition model. Hence, starting from rather big organic compounds, microbes and the abiotic environmental factors continuously disintegrate the SOM into progressively smaller molecules. They then become more soluble in water because transforming into more polar and ionizable groups. Concurrently these organic molecules become more stable, as being more reactive with decreasing size and thus interacting with mineral surfaces or establishing aggregates with other organic molecules and soil particles. In that way the SOM particles can be protected from further decomposition and mineralization by soil microbes (Lehmann & Kleber, 2015).

2.2.3 POM and MAOM Framework

The idea of separating SOM into two different main pools, namely the particulate organic matter (POM) and the mineral associated organic matter (MAOM) pool is only a few years old. However, it has gotten great feedback and is now widely used in the soil science community, although as already mentioned before, there are still players sticking to the theory of humic substances, which eventually results in a great debate about which path should be followed for achieving a future consensus. The POM fraction mainly consists of big, undecomposed lightweight compounds, and the MAOM is made up of smaller fragments. The latter have either been chemically transformed by the soil biota or directly leached from plant material. MAOM

represents the stable OM pool, as it is protected from decomposition through chemically binding on mineral surfaces. Additional to the binding on minerals, MAOM can be occluded within micropores or small aggregates and thus become less exposed to the decomposing mechanisms of microbes. This all leading to much greater persistence of MAOM compared to the persistence of POM. The distinct chemical characteristics of the two fractions are thought to derive from the different pathways these compounds traverse.

In the consecutive section the two main pathways of mentioned SOC pools are being explained shortly. The POM portion enters the mineral soil originating from the litter and the rhizosphere, being broken up, which mostly is all the microbial processing it receives. The MAOM on the other hand has got multiple pathways, but the most important ones have a common underlying mechanism: the adsorption of low molecular weight compounds. This adsorption can be achieved in two different ways. These low molecular weight compounds either leach directly from plant litter or they are produced by exoenzyme depolymerization of the very same plant litter and after both the associate directly with the mineral phase, which is the first pathway, namely the “ex vivo modification pathway”. The second pathway is called the “in vivo microbial turn-over pathway”. It describes the mechanism of microorganisms, nourishing from dead OM and thus decomposing and transforming it, which eventually results in necromass, as these microbes will surely die at a certain point, or in exudates. Following this pathway, only after the mentioned processes, the low molecular weight compounds will be incorporated into the MAOM fraction. Generally, MAOM has got a lower C/N ratio, exactly because of the bigger amount of the microbial derived products and therefore a smaller part of directly plant-derived OM, which would contain less N and thus have a higher C/N, such as the POM fraction. Other differences between the two pools include, that the MAOM usually contains more nutrients, is faster decomposed and depolymerized, meaning it can be assimilated by plants and or microbes faster and easier than the POM fraction.

Concluding this chapter, can be stated that lots of recent studies focus on the POM and MAOM framework, especially regarding the sequestration of SOM. The accumulation of MAOM in terms of increasing SOC, can be tough as it needs more N compared to POM, additionally there needs to be a lack in saturation on mineral surfaces. This is why the accumulation of POM may be underrated in terms of C sequestration, even if its formation needs to happen at a higher rate than its decomposition, which ultimately is also of an important role regarding the fertility of the soil itself (Lavallee et al., 2020).

3 Hypotheses

Following the hypotheses met for this work are listed. They were formulated considering all the information stated so far, as well as the experimental design of the entire research project.

- H1) Pioneer management systems approximate the SOC storage potential of permanently vegetation covered (semi) natural reference soils, closing the SOC storage deficit of current standard management systems.
- H2) DOC provides a more sensitive indicator for management differences compared to SOC.
- H3) SOC quality indicators (C/N) reflect the distinct SOC stabilization mechanisms due to differences in site specific soil properties (clay content, iron oxides, pH, CEC, Ca⁺⁺).

4 Materials and Methods

For collecting the soil samples, 21 sites in semi-arid eastern Austria have been chosen with the aim of representing typical soil types. Additionally, these specifically chosen sites are all part of an active agricultural undertaking which focuses on improving soil quality and increasing SOC on their fields. A complete list of all sites, their names and their district can be found in Table 2. 17 of the study sites are located in the state of Lower Austria and the remaining 4 sites are located in the state of Burgenland. A map of the exact positions of all study sites can be seen in Figure 6. Each study site represents three different management systems:

- Conventional agricultural land, with typical crops and traditional management measures. Henceforth referred to as the standard system.
- Pioneer agricultural land, which encompasses innovative agricultural management measures, such as reduced or even no tillage at all, the use of cover crops in the off seasons and crop rotations, as well as a higher input of organic material through the use of manure or compost. Henceforth referred to as the pioneer system.
- And an at best uncultivated patch of land resembling an untouched ecosystem and therefore natural undisturbed soil, situated in close range to the other systems. This management type is henceforth referred to as the reference system. The data gained from sampling and analyzing it, are used as a benchmark for what would be possible in terms of storing organic carbon and regarding other soil quality indicators, if there was no direct and recent human influence on the soil.

Samples have been taken at three depths of each management system on every study site, 4 repetitions of the same sample have been made. This sampling design results in a total of 756 samples ($21 \times 3 \times 3 \times 4$). The depth ranges from which the samples have been taken are: 0-5 cm, 5-20 cm, and 20-35 cm. A schematic representation of the sampling system can be seen in Figure 7.

Table 2: In this table a comprehensive list of all the sites and their locations is given. The chosen site name always refers to either the name of the town or municipality where the sample was taken. Further the district and the Austrian state are listed for a deeper understanding of the position. As may be noticed, in some towns/municipalities two sampling sites are located, that is when the additional numbering as a suffix is used.

Site No	Site Name/Town/Municipality	District	State
1	Absdorf	Tulln	Lower Austria
2	Au am Leithaberge 1	Bruck an der Leitha	Lower Austria
3	Au am Leithaberge 2	Bruck an der Leitha	Lower Austria
4	Groß Burgstall1 (toeslope)	Horn	Lower Austria
5	Groß Burgstall2 (shoulder)	Horn	Lower Austria
6	Eisgarn	Gmünd	Lower Austria
7	Fischamend	Bruck an der Leitha	Lower Austria
8	Grübern	Hollabrunn	Lower Austria
9	Lackendorf1	Oberpullendorf	Burgenland
10	Lackendorf2	Oberpullendorf	Burgenland
11	Mannersdorf1	Bruck an der Leitha	Lower Austria
12	Mannersdorf2	Bruck an der Leitha	Lower Austria
13	Moosbrunn	Bruck an der Leitha	Lower Austria
14	Rodingersdorf1	Horn	Lower Austria
15	Rodingersdorf2	Horn	Lower Austria
16	Steinabrunn	Korneuburg	Lower Austria
17	Schachendorf1	Oberwart	Burgenland
18	Schachendorf2	Oberwart	Burgenland
19	Stockerau	Korneuburg	Lower Austria
20	Theresienfeld	Wiener Neustadt	Lower Austria
21	Umbach	Melk	Lower Austria

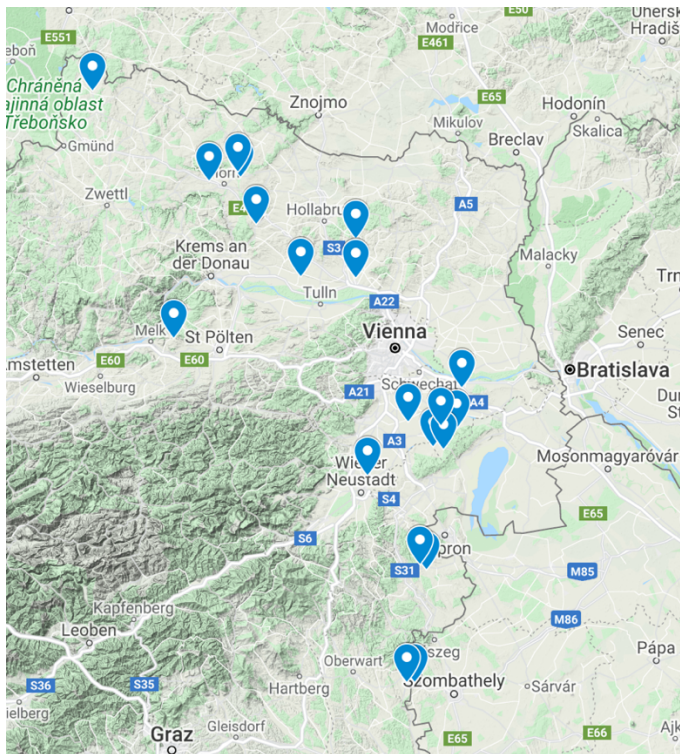


Figure 6: In this map a on overview of the locations of the 21 sites is given. 17 of these locations are located in the region of Lower Austria and the remaining 4 are situated in the region of Burgenland.

4.1 Pooling and Sieving: Separation in Bulk and Aggregate Subdivision

The description of the methods used for this work, starts with the laboratory tasks, because those are the ones conducted by the author of the present thesis. The sampling on the field itself, has been conducted by another team of scholars, working all for the same greater research project. If an in-depth understanding of the sampling technique is desired, the works of Luger, D. and Sae-Tun, O. should be taken to hand.

The first step regarding laboratory tasks, consisted of pooling the four replications to one single sample, being more representative as being more homogeneous in that way. This was obtained by mixing four equal parts, one of each replication and creating one new representative sample of that specific site, system, and depth. After that, this newly obtained samples were sieved through a 2 mm mesh and then a 1mm mesh. The fraction smaller than 2 mm but greater than 1 mm represents the aggregate part of the soil and the fraction smaller than 1mm and larger than 2 mm is the bulk sample, the latter one is used for all the here described methods. Whereas the aggregate part is used for other analyses and problems, not further mentioned in this work.

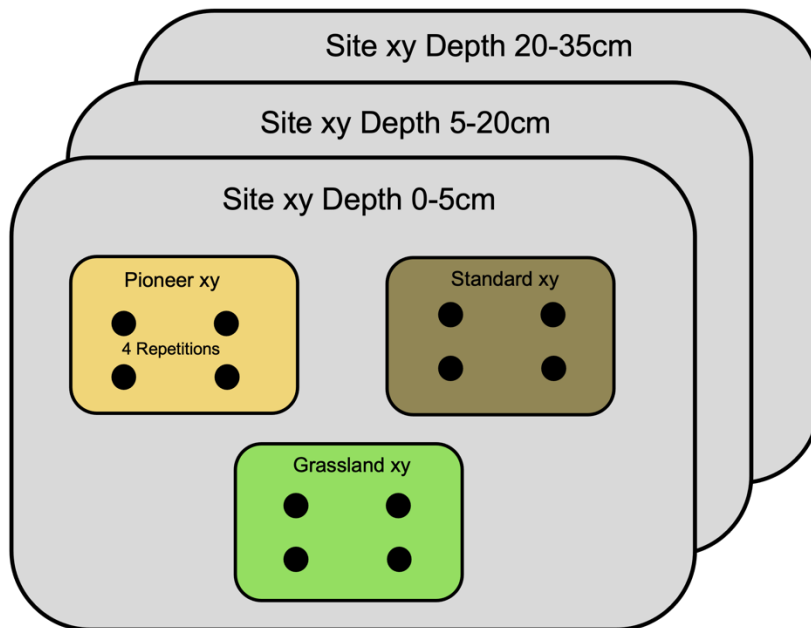


Figure 7: Schematic representation of the system used for collecting the soil samples. Three different systems (pioneer, standard and grassland) at close range to each other (within site xy), three depths (0-5, 5-20 and 20-35cm) on each of the systems. There have been taken 4 replications (here represented by the dots) of each sample. The same approach has been used at all 21 sites. A total of $(4 \times 3 \times 3 \times 21 \Rightarrow)$ 756 samples were collected during the sampling period on the field.

4.2 Further Sample Preparation: Drying and Milling

The samples underwent a minimum of 48 h drying process in the drying closet at a temperature of 60° C. After that they are put in a desiccator for cooling down, without running the risk of absorbing any air moisture through condensation. Then the samples got ground in a ball mill type Retsch MM200 in order to achieve the necessary grain size for the remaining analyses.

4.3 Total N and Total C Measurement

With the much-appreciated help of the Universities laboratory staff the following analysis was conducted not directly by the author of the present thesis. An approximate mass of 50 to 100 *mg* of each sample was then transferred into tin capsules, and the exact weight was determined with a high precision scale from the manufacturer Sartorius and noted down. For the actual measurement of the *N* and *C* contents, a thermo scientific “FlashSmart” element analyzer was used. After putting the sealed tin capsules into the incineration chamber of the device, the following gases got separated through a gas chromatography column: N_2 , CO_2 , H_2O and O_2 . The successive thermal conductivity detector quantified the amount of each of the beforehand separated gases. Once the total amounts of *N* and *C* have been identified, it was just a matter of contrasting the values to get the *C/N* ratio. These measurements are standardized and thus represented by the ÖNORM L 1080.

4.4 Water Extracts: pH & EC, DOC

For the analyses of the pH, EC and DOC water extracts of every soil sample were needed. The following is an abridged explanation of this rather simple task. 5 g (with an allowed deviation margin of 0.002 g) were weighed of every sample and put in the shaker bottles together with 50 *mL* of purified H_2O . This was then left for overnight soaking, after which it got shaken for 2 hours. Then the filtration process was initiated, and all aqueous samples were filtered through a fluted filter with a mesh size of 0.45 μm . The so obtain extracts were split into identical parts, as one was used for the DOC measurement with the diode array detector and the other replication was used for the pH and EC measurement. By doing so a pristine sample for DOC was assured, as the pH measurement alters the composition of the extract itself. The pH and EC measurements were conducted using a multiparameter device, type “inoLab Multi 9620 IDS” with both pH and EC sensitive electrodes. These analyses are standardized and are represented by the ÖNORM L 1083 (pH) and ÖNORM L 1092 (water extraction and EC measurement).

4.5 DOC Measurement

As mentioned above, a replication of the filtered water extract was used for the DOC measurement as well. Problems encountered in this step included the presence of colloids, which could not be filtered either with an additional $0.45\ \mu\text{m}$ nylon syringe and plenty of applied force. As a result, the decision was made to fill the extraction samples into 2 mL Eppendorf tubes and use a centrifuge, type “Hettich” in which the tubes got accelerated for 10 min at a frequency of 15,000 rpm. Consequently, the disturbing colloids got pressed to the bottom of the tubes through the g-force of the centrifuge and the upper part of the extraction in the tubes was aspirated by a syringe and could be used for the DOC analysis.

The DOC analysis itself was carried out with the use of an “Agilent 8453” UV-VIS diode array spectrophotometer and an attached personal computer with the respective program (Agilent 845x UV-visible system online) installed and running. A brief explanation of the working principle of this kind of spectrophotometer follows, a schematic representation of the device’s inner life can be seen in Figure 8. An extended range of light wavelengths is emitted from a Tungsten and a Deuterium lamp, hence the name UV and VIS, the latter referring to the for humans visible set of light waves. After passing a lens and a shutter, the light waves will pass through the soil sample extraction. Successively, they pass through another lens, a slit and a grating to eventually hit the “1024-element” diode array, which will detect the incoming wavelengths and record them. As a result, the absorbance of different wavelengths can be measured, which is directly linked to the presence of particles in the size range of said wavelengths. As soon as light waves collide with particles present in the soul solution, they get reflected and scattered in different direction than the one following the process path within the device. Within the range of 190 – 1,100 nm it is possible to set specific wavelengths at which the absorbance must be measured. For this work and the linked questions, the following wavelengths were chosen: 210, 254, 400 and 600 nm. The most interesting was the 254 nm, given that this is the wavelengths absorbed by the DOC. To calculate the DOC content an equation is needed dealing with the measured absorbance. Said equation comes from a transformation of the Beer-Lambert law.

$$A = \varepsilon * \ell * c$$

Eq. 1: This is a practical and common expression of the Beer-Lambert law.

Where:

A = absorbance

ε = molar attenuation coefficient

ℓ = optical path length in cm

c = concentration of the attenuating species

With the help of this just mentioned law, the following equation used for the calculation of the DOC is gained.

$$DOC = 0.449 * A_{254nm} + 1$$

Eq. 2: The equation used for the determine the DOC amount through the measured absorbance at 254nm.

Where:

DOC = dissolved organic carbon in the unit of $mg * L^{-1}$

A = absorbance given in m^{-1}

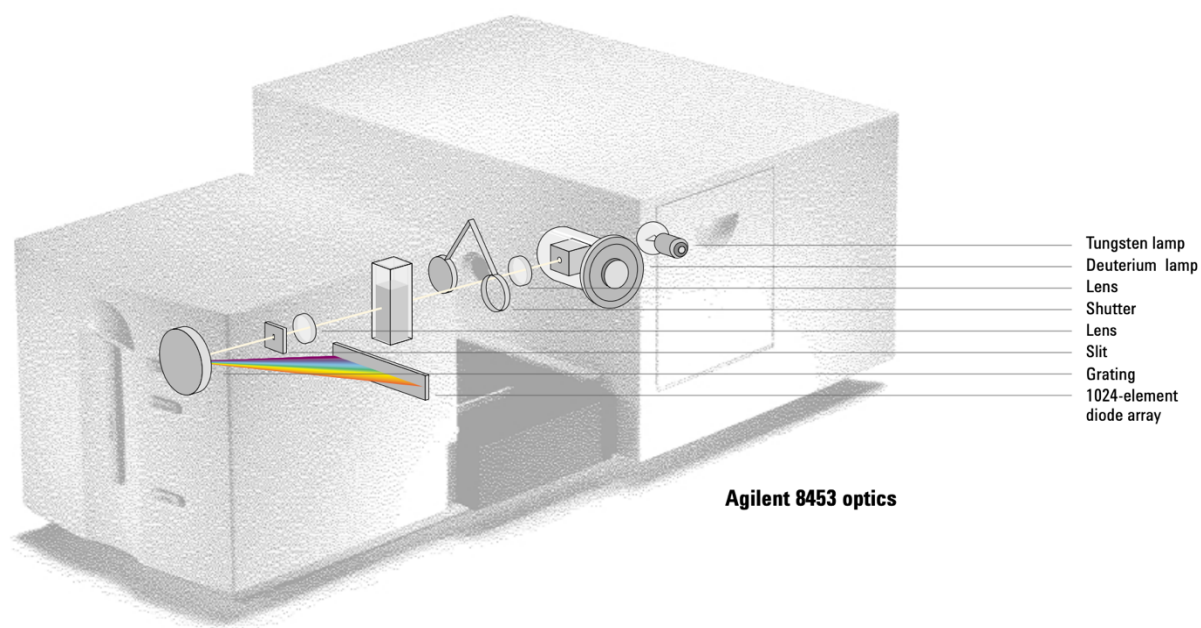
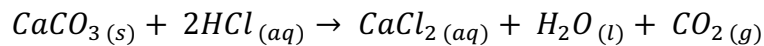


Figure 8: Schematic representation of the components present inside the "Agilent 8453 optics".

4.6 Scheibler: Determination of Inorganic Carbon

In order to determine the net organic carbon content from the data recovered with the total C analysis, a method for calculating the inorganic carbon content, or carbonate is necessary. The Scheibler method is a proven and reliable analysis for measuring carbonate content of soil samples which is cemented in the Austrian Standard ÖNORM L 1048 from 2016.

At the start of this method each sample was weighed with the same high-precision scale mentioned before, and those values were noted down. Successively, the sample was put in a glass container, especially designed only for this method. In the very same container, the 6 M HCl needed for the evaporation of the inorganic C is poured, but still separated from each other. Once the rubber tube is connected to the glass container and thus the loop of the airtight system is closed, the container is tilted and swiveled to mix the two compounds, so they can react as explained below by the equation X. The acid then evaporated all the inorganic C in form of CO_2 from the soil. After approximately 10 to 15 min the reaction is done and the temperature, the air pressure and the volume evaporated is recorded, as these values were needed for the equation X, to calculate the % of $CaCO_3$ present in the soil sample.



Eq. 3: The chemical reaction which is principle to the Scheibler Method.

$$CaCO_3\% = CO_2 * TV * 2.274 * \frac{100}{SM}$$

Eq. 4: The mathematical equation needed to calculate the % of $CaCO_3$ with the parameter values obtained from the Scheibler Method.

Where:

$CaCO_3\%$ = The amount of calcium carbonate expressed in mass percentage of the sample

CO_2 = The amount of carbon dioxide evaporated from the reaction in mL

TV = The conversion multiplicator used for translating the volume of CO_2 into mass, which is found in a specific table using the measured air pressure in hPa and temperature in $^{\circ}C$ to define the fitting value

SM = Mass of the soil sample in mg

4.7 Oxalate Extraction: Fe, Al, Mn

For the determination of some more typical soil attributes, such as the presence of pedogenic metals an oxalate extraction of the samples was necessary. Firstly, the oxalate solvent needed to be produced, as this is a light sensitive chemical, everything connected to this method had to be protected from the light rays.

For the analysis of the species and number of metals present in the soil samples and extractable by oxalate an inductively coupled plasma mass spectrometer (ICP-MS) was used. The instrument used, offers a helium mode collision cell that remove both polyatomic and charged ion interferences. The sample is firstly atomized with the help of a plasma torch and the help of a reaction gas (usually Ar), after which the atoms go through a few cones to get extracted from the plasma, the successive collision cell removes interfering ions. Then the actual detection starts, which is represented by the quadrupole mass spectrometer as the second step of this instrument. After the ions are separated by their mass/size ratio the measured signal is converted into readable data on a personal computer with the respective program installed.

4.8 Dithionite Extraction: Pedogenic Oxides

For the determination of pedogenic oxides of metals such as *Al*, *Fe*, *Mn* and *Si* and extraction of the soils sample must be done beforehand. The extracting agent, in this case Dithionite, consisted of a 0.3 mol $C_6H_5Na_3O_7 \times 2H_2O$ (trisodium citrate dihydrate) and 1 mol of $NaHCO_3$ (bicarbonate of soda) and had to be produced by compounding these chemicals in the right ratio and adding it to deionized water. At this time, the soil samples got precisely weighed and put in a 250 mL PE-shaker-bottler and mixed with a precise amount of $Na_2S_2O_4$ (dithionite sodium). Successively 100 mL of the before produced extracting agent were added. The bottle was then mounted on the shaker and got shaken for 16 h. After that, the extract had to be filtered through a 0.45 μm fluted filter, while always discarding the first few drops dripping down in the new vessels. The Analysis of the detectable metals from the Dithionite extraction is the very same as the one described above in chapter 4.7 for the Oxalate extracted metals.

4.9 Barium Chloride Extraction: CEC

The cation exchange capacity (CEC) is a classic indicator in agronomy and soil sciences for a soil's quality and productivity. In this analysis the negatively charged sites on soil particles are measured, in order to understand how many cations, the soils could possibly bind. Typical cations are calcium (Ca^{2+}), magnesium (Mg^{2+}) and potassium (K^+) although this might be pH

dependent. The CEC is an important factor, as it expresses how many cations are available to plants as nutrients. It is measured in moles per charge per mass of soil, e.g. $cmol(+)/kg$. Before starting with the CEC analyzing method itself, another extract must have been produced. This time it was a barium chloride ($BaCl_2$) extraction, which got added to the air dried and weighed soil sampled and transferred to the rotary shaker once again. The solution was filtered, in order to just obtain the liquid phase. This then got transferred to the atomic absorption spectroscopy (AAS) workstation. The working principle of the AAS the measured absorption of optical radiation of an atomized sample in its gaseous state. The absorbance is then detected, amplified and finally the signal is processed and translated in comprehensive data. This method is standardized by the Austrian Standardization Organization and depicted by the ÖNORM L 1086.

4.10 Aggregate Stability

The results of the aggregate stability were taken from a dear colleague who worked on the same research project at the institute of soil research: David Luger. For the detailed description of the methodology regarding that analysis please consult his master thesis.

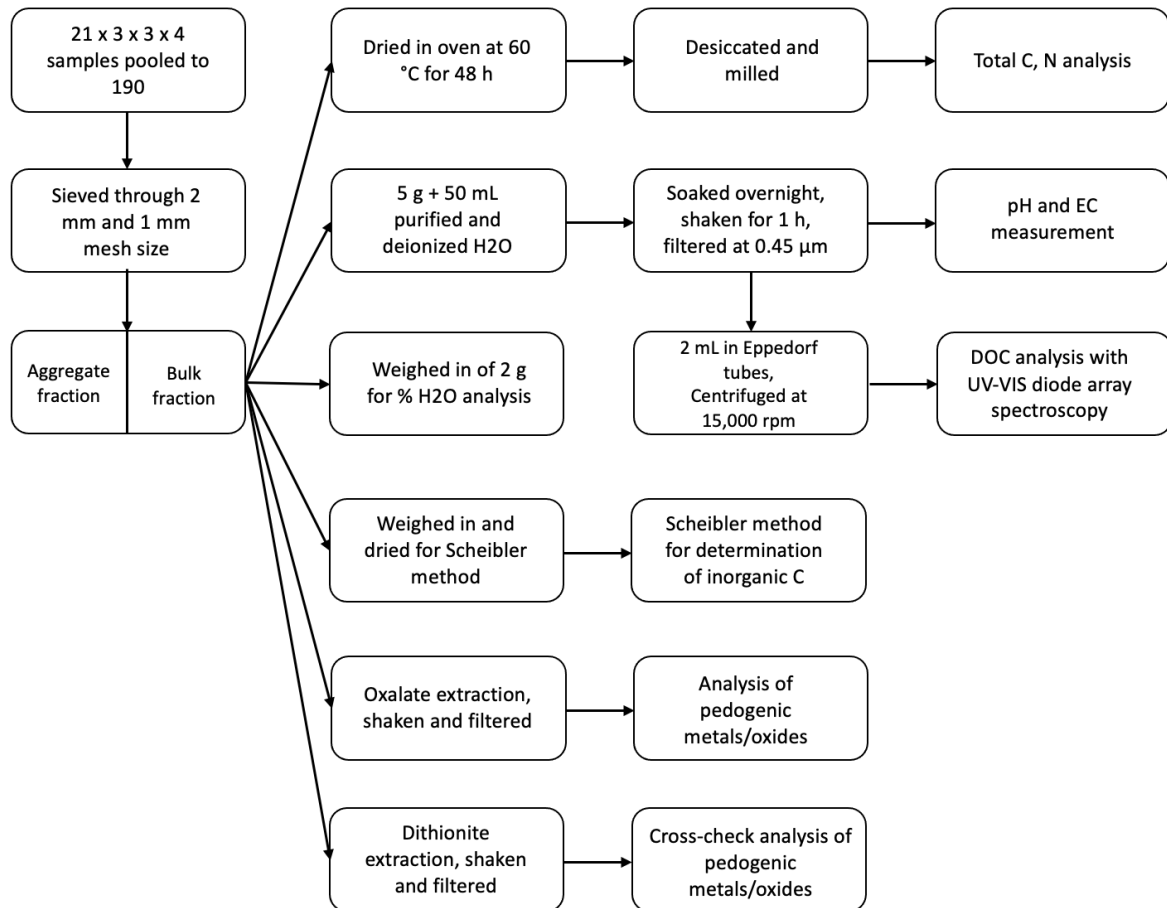


Figure 9: Chart representing a summary of the most important steps and processes executed in the laboratory.

5 Results

In this chapter the through multiple analyses acquired data sets will be showcased with regard to the initially stated hypotheses.

5.1 General Soil Indicators

In the following subchapters results of some of the rather general soil parameters will be shown. Firstly, a graph depicting the mean aggregate stability of the different management systems.

5.1.1 Soil Types and Texture Classes

Table 3: Soil types and soil texture classes described for each sample site, but only for the pioneer system soils. Although these indicators rarely differ between the examined systems, there are exceptions. For the soil type classification, the updated World Reference Base for Soil Resources (2105) is taken to hand and for the texture classification the Food and Agriculture Organisation of the United Nations' Guidelines for Soil Description (2006) are used.

Site No	Site Name	Soil Type (WRB)	Texture Class (FAO)
1	Absdorf	Calcaric Phaeozem	C
2	Au am Leithaberge 1	Calcaric Phaeozem	CL
3	Au am Leithaberge 2	Leptosol	SL
4	Groß Burgstall1 (toeslope)	Leptic Cambisol	L
5	Groß Burgstall2 (shoulder)	Leptic Cambisol	SL
6	Eisgarn	Leptic Cambisol	SL
7	Fischamend	Chernozem	SiL
8	Grübern	Chernozem	SiL
9	Lackendorf1	Cambisol	SL
10	Lackendorf2	Gleysol	L
11	Mannersdorf1	Haplic Phaeozem	L
12	Mannersdorf2	Fluvisol	SiCL
13	Moosbrunn	Calcic Phaeozem/Chernozem	CL
14	Rodingersdorf1	Ferric Stagnosol	L
15	Rodingersdorf2	Luvisol	SiL
16	Steinabrunn	Haplic Regosol (Loess)	CL
17	Schachendorf1	Stagnogleyic - Cambisol	C
18	Schachendorf2	Histic Gleysol	SiL
19	Stockerau	Chernozem	SiL
20	Theresienfeld	Calcaric Leptosol	SL
21	Umbach	Luvisol	SiCL

The highest clay content is found in the soils of the Absdorf sampling site, the soil type categorized is a Calcaric Phaeozem and the texture class is Clay. The analyzed clay content of this specific soil is 51.841 %, the silt is 39.585 %, and the rest, namely 8.574 % is unambiguously sand, of which 6.506 % points are part of the Fine Sand fraction. With only

9.999 % Lackendorf 1 on the other hand, is the site with the lowest clay content. Moreover, Lackendorf 1 consists of 29.758 % silt and 60.242 % sand, which classifies it as a Cambisol with the texture class Sand Loam. An overview of the sites and the corresponding soil types classified by the World Reference Base for Soil Resources and the respective texture classes as described by the FAO can be found Table 3.

5.1.2 Aggregate Stability

Soil aggregates vary greatly in size and shape and are formed by OM, primary and secondary particles. The term stability refers to the individual property of the aggregates to withstand mechanical stresses such as tillage and wetting by raindrops, which from a certain degree on would normally cause a disintegration of the aggregates. As an important physical variable, it describes how well-structured the soil is. That in turn gives for agriculture important information about the aeration, water storage and biological activity of the soil. Meaning, the higher the aggregate stability value is, the more stable the aggregates are, the more stable the present soil structure is, allowing for enough pore space to have good prerequisites regarding the above-mentioned characteristics. Furthermore, the aggregate stability has got great influence on soil degradation processes, such as erosion or crusting.

The mean aggregate stability values of the different systems over all sites are shown in figure 8. The highest level of mean aggregate stability is to be found in the reference system, namely 0.73, compared to the lowest of 0.49 in the standard systems, the pioneer system's value lying in the mid with its 0.55. As can be seen in the figure these mean values are highly significantly different from each other and thus have a statistical integrity. The importance of this usually rather general indicator regarding the OC content of a soil is explained in the next section, the discussion. A graph depicting the above-mentioned numbers can be seen in Figure 10.

5.1.3 Soil pH

The laboratory pH analyses shows that the standard management system have got the lowest mean pH with a value of 7.32, followed by the reference system with a mean pH of 7.41, the pioneer system thus representing the soils with the highest pH at a mean value of 7.49. In later chapters possible correlations between the soil pH and the SOC or the DOC values are being shown. Additionally, a graph showing the mean pH values of the different management types can be seen in Figure 11.

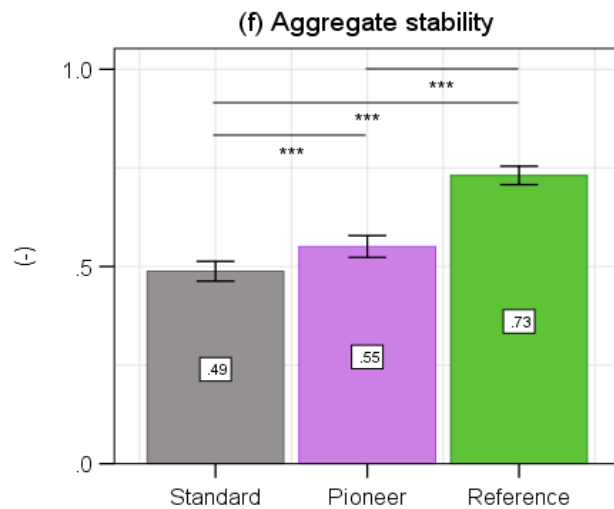


Figure 10: Here the mean aggregate stability values for the three different systems are being compared to one another. As one can rapidly recognize, the reference system disposes over the most stable aggregates with a value of 73%, followed by the pioneer system with 55% stability and the standard system representing the most fragile aggregates with a stability of 49%. The aggregate stability may be linked to the quantity and quality of the C present in the soil, as it has got an important role in the formation of these aggregates (Papadopoulos, 2011).

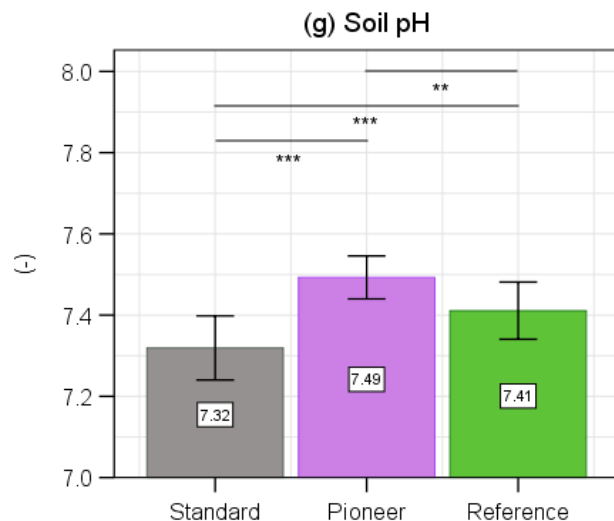


Figure 11: Since none of the analysed systems appeared to be acidic in their mean pH, it can be stated that bacteria will prevalently be active as the decomposer community in the tested soils. The standard system representing the bottom line in terms of pH with a value of 7.32, the reference system being in the middle with a surprising 7.41 and the pioneer system topping of the list with a mean pH of 7.49.

5.1.4 Nitrogen

The standard management system has got the highest percentage of total N, namely 0.29%. The two remaining systems are already more comparable to each other in terms of total N quantity: the pioneer, with a value of 0.184% is thus much closer to the reference system with 0.145% of total N. The percentages express the mean value of the respective system, and they are all highly significant in statistical terms. The standard system is clearly the emphasized one in this case, as the difference between the reference and pioneer system is at 0.039% points, the standard system in contrast, has exactly double the amount of N of the reference system available. In other words, the reference system has 100% more total N than the reference, whereas the pioneer only has roughly 27% more total N than the reference system, as shown in Figure 12.

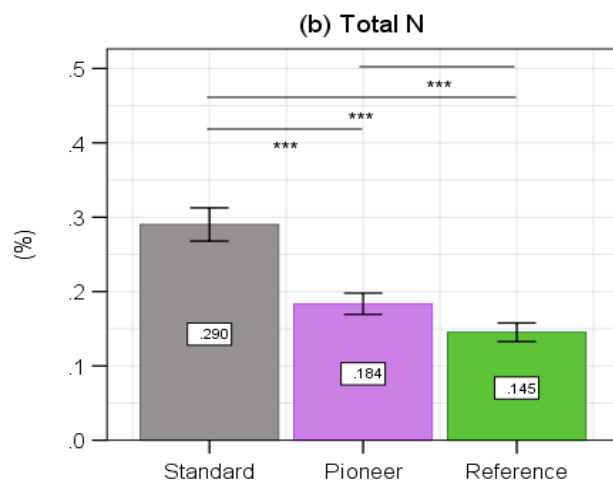


Figure 12: The data gained through a total N analysis clearly shows the highly significant differences in mean total N percentages. The highest value of 0.29% N in the standard system may be traced back to a man-made addition of N fertilizers to the crops. There is already a big difference when comparing it to the pioneer system, which contains a mean 0.18% of N in its soils, as the synthetic fertilizers are omitted contrary to the standard system. However, the least N contains the reference system, also exhibiting a highly significant mean difference compared to both other systems at a value of about 0.15% total N content. As seen by this example, the most natural system proves to dispose over the least total N in its soils.

5.1.5 EC

The results from the conducted EC analysis are shown in Figure 13. The standard systems, similarly, as with the soil pH and the aggregate stability, representing the lowest value, with

98.5 mS/cm^2 . The pioneer system being in the middle, with 119.0 mS/cm^2 , and the reference system taking the top spot in the order, with an EC of 142.8 mS/cm^2 . These values represent the mean EC for each system, gained by analyzing all of the 188 samples, or 63 per system. The differences in the EC compared within the systems, are again, highly significant.

The EC value is an expression of how many negatively charged particles or sites are present in a soil. Additional to the anions the surface of clay and OM is negatively charged too. The higher this value, the more cations a soil must contain, as they are attracted to the negatively charged sites. Plant nutrients which are important to healthy plant growth are mainly cations, such as sodium (Na^+), ammonium (NH_4^+), potassium (K^+), calcium (Ca^{2+}), magnesium (Mg^{2+}), hydrogen (H^+), iron (Fe^{2+}), aluminum (Al^{3+}), copper (Cu^{2+}), zinc (Zn^{2+}) and manganese (Mn^{2+}). It is important though, that the EC does not get too high either, as some of these nutrients, such as Na^+ and Mg^{2+} can be unfavorable for the soil ecosystem. This information gives a hint, that the EC can already be seen as an indirect physical indicator about the OM content in soils. Following data found in literature the optimal EC in soils ranges from 110 to 570 mS/m .

As already mentioned, there are a few key players in terms of influencing the EC of a soil, the soil texture, the soil salinity, and the soil moisture. The bigger the sand and silt fraction of a soil, the lower the EC may be, as these fractions tend to conduct less charged particles. This leads to sandy soils disposing of less cations and therefore nutrients and even losing them easier compared to silt or even clay. However, very high EC values e.g., $>1,600 mS/m$ are an indicator for saline soils, as the salinity in soils drastically enhances the EC. The most crucial cation in regards of the salinity of a soil is the Na^+ . In soils of cultivated land, it should not exceed the 100 mg/kg of soil mark, as this can lead to a salinification and thus complete deterioration of a soil. The moisture of a soil simply has a big impact on the EC because more cations will go in solution if the soil is wet, and water itself is a good conductor as well, so it will just act as a multiplier of the genuine EC in dry conditions (Fourie, 2019).

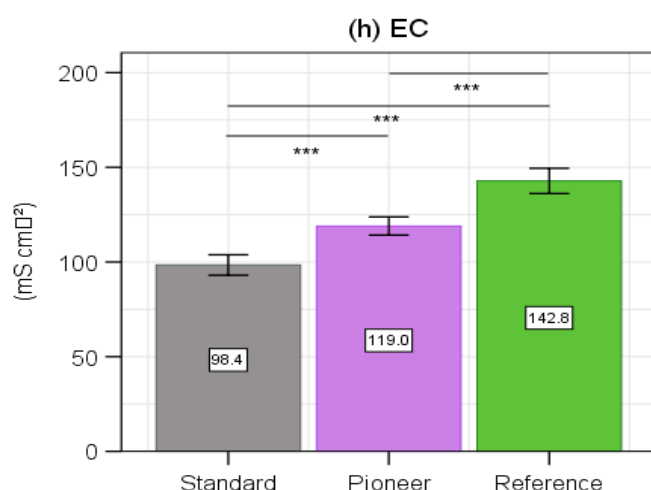


Figure 13: In this boxplot the difference in mean EC values between the three management systems are shown. The standard system constituting the lowest EC with a value of 98.4 $\mu\text{S}/\text{cm}$, the pioneer system disposing over an EC of 119 $\mu\text{S}/\text{cm}$ and the reference system representing the highest mean EC value, with a highly significantly different value of 142.8 $\mu\text{S}/\text{cm}$ compared to the other two systems. On cultivated lands and their soils, the EC is taken as an indirect indicator for the amount of plant available nutrients present in the soil, or measured as a proxy for the CEC, the soil texture, the water-holding capacity, or the drainage conditions.

5.1.6 DOC

The results gained from the UV-VIS spectrophotometer analysis are shown in Figure 14. This proves that the DOC fraction of the total OM present in the soils studied, is highest in the reference system, with a relatively high mean value of 348 $\mu\text{g}/\text{g}$ of DOC. It is followed by the pioneer system with a mean 217 $\mu\text{g}/\text{g}$ of DOC present in these systems over all three depths and the standard system proves once more to be the poorest in this regard, by displaying a rather low mean DOC content of 168 $\mu\text{g}/\text{g}$ of soil. All the three means are statistically highly significant compared to each other. As can be seen, the reference soil still is far ahead the pioneer in terms of sheer DOC quantities, however the pioneer system stands out in comparison to the standard system, with a mean difference of 49 $\mu\text{g}/\text{g}$ of DOC between the two systems. This number represents an increase of OC through the pioneer management system of about 29.17% in respect to the standard management system. Which is a lot, considering the volume and therefor mass of soil present on these fields.

However, it is also possible to see what the norm could be if the land was untouched. Looking at the mean reference value from the grassland, it quickly becomes clear there is much room for improvement in terms of DOC content from the pioneer systems as well. The mean

difference between the two systems is of 131 $\mu\text{g/g}$ of DOC, which expressed in a ratio, is a net reduction of 37.64% of DOC in the pioneer soils compared to the reference land. As all of this land, once used to be reference land, and therefore grassland, before it has gotten cultivated millennia ago, it can be stated that these analyzed differences of DOC, simply have been lost through the agricultural management measures applied on these croplands over all this time. Using the correlations from the statistics that have been made for this work, reciprocal influences can be observed. For the DOC the most influential parameters with the highest correlations and very high statistical significance are: the OC, which does not come as a surprise given the fact, that the DOC is merely a fraction of the total OC; closely followed by the aggregate stability; then the EC. These three parameters all represent a positive correlation with the DOC, which is why the figures of the very same indicators look quite similar to the one of the DOC used in this chapter. On the other hand, there can be found some significant negative correlations as well. These regard the soil texture: sand and silt with coefficients of -0.222 and -0.216 respectively. This just affirms the fact, that the clay fraction of a soil texture is the one connected most to SOC content, as complexes are formed between aggregates and OM due to the different electrical surface charges. This naturally leads to the fact, that the more sand and silt a soil contains, the less clay it incorporates, meaning less DOC can temporarily be bound on its surface.

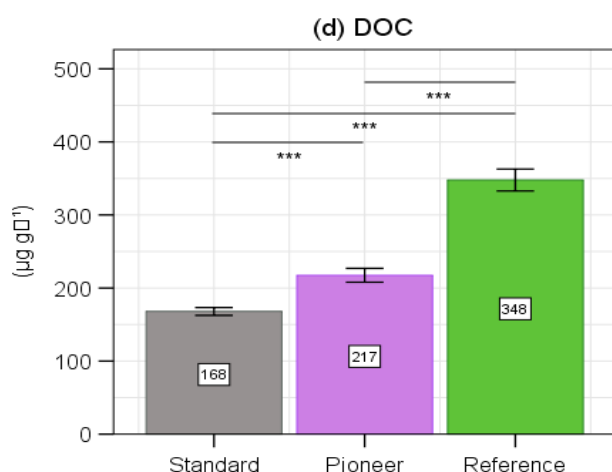


Figure 14: This graph depicts the mean values of dissolved organic carbon (DOC), which the different systems contain. The standard system shows the lowest value at 168 $\mu\text{g/g}$ of DOC, followed by the pioneer system at 217 $\mu\text{g/g}$ of DOC, which represents an increase of 29.17% compared to the standard system. The highest mean value regarding DOC, is to be found in the reference system. The predominantly grasslands display to contain a mean 348 $\mu\text{g/g}$ of DOC, which represents a net difference of 180 $\mu\text{g/g}$ and 131 $\mu\text{g/g}$ compared to the standard and the pioneer systems respectively. Remarkable

and highly interesting for this work however, is the difference between the standard and the pioneer, that contains 49 more μg of DOC compared to its antagonist the standard management system.

5.1.7 SOC

In the following section the results of the OC content analyses are being displayed. In the literature the term SOC is more widely used, however the same is meant with OC in this work. The results gained from the analysis are shown in Figure 15. The differences in the mean OC content among the management systems and the reference soils are all statistically very significant to each other. The lowest mean OC content is to find in the standard management systems, which on average dispose of 2% OC. Followed by the pioneer management systems, already showing an average increase of 0.4% and therefore containing a mean 2.4% OC in their soils. The grassland soils i.e., the reference systems contain, once again, the greatest share of OC, with a mean fraction 3.7%. There still is to find a rather big gap in terms of total OC between the natural possible maximum and the two managed systems. However, considering the surface area and the depth of the examined soils, the 0.4 percentage point increase in OC from standard to pioneer system has a significant impact on the total quantity of C sequestered and can thus be understood as an important GHG mitigation strategy.

The highest positive Pearson correlation coefficient is to be found between the OC and the aggregate stability, namely 0.713 with a high statistical significance. With a value of 0.695 the second highest positive correlation is observed to be between the OC and the DOC, which is not a surprise given the DOC is a fraction of the total OC. This correlation also represents a high statistical significance. Also of notable interest is the third highest positive Pearson correlation coefficient of 0.593, between the OC and the EC values. Meaning the OC content of a soil significantly affects the EC, naturally this phenomenon is caused by the electrical charge of the OC particles which leads to increased overall electron flow in the soil solution and therefore higher EC values. However, on the negative correlation side the Pearson coefficient with the texture class silt is worth a mention. With a value of -0.318 it represents the biggest negative correlation of OC. The other two texture classes are correlated positively, which for clay comes foreseeable, for sand it may not though. This and other unexpected outcomes from the analyses will be confronted in the discussion part of this work.

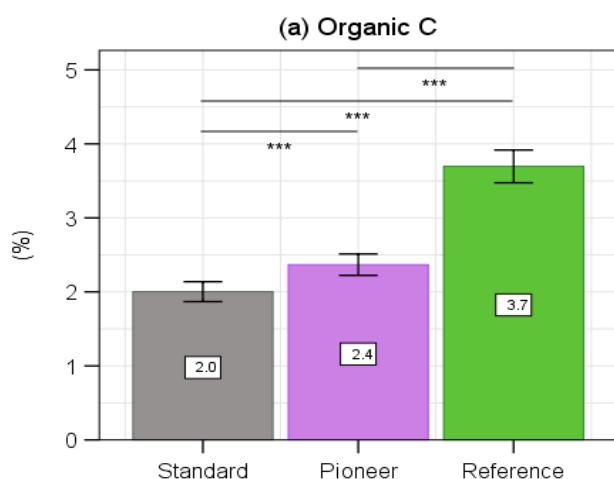


Figure 15: In this figure the mean OC contents of the different examined systems are depicted. The standard systems contain 2% OC on average and thus represent the quantitative smallest carbon stock. The pioneer systems already show a mean relative increase of 20% regarding the OC content and hence the carbon stock. Expressed in percentage points the net increase of OC present in the soils is 0.4% in comparison to the standard systems mean value. The reference systems i.e., the grassland soils contain the highest amount of OC, described by the 3.7% of mean OC content. There is a difference of 1.3 percentage points between the pioneer and the reference systems, which seen relatively is an increase of 54.17%. The contrast between the reference and the standard systems mean values is even more dramatic, as the net percentage points increase is of 1.7 and the relative increase is of 85%.

5.2 Additional Parameters

Until now only single parameter values have been shown, and their correlations to other parameters analyzed are mentioned. In the following section, parameter-values will hence be compared and confronted to each other. The idea is to get a greater picture of how these management measures are affecting not only single parameters, but rather ratios and groupings of more than one at a time.

5.2.1 C to DOC Ratio

Here is looked at the ratio of the total C to the DOC fraction of the soil. This is done with the hypothesis 3 in mind, to understand if the DOC is in fact a more sensitive and maybe even a more reliable parameter for classifying C sequestration in soils.

Figure 16 shows the results gained from the analyses of the two individual parameters and the subsequently calculated ratio. It illustrates, that the standard system has got the greatest ratio, thus containing more C per DOC. Indicating, that the DOC fraction is relatively smaller compared to the total C than in the soils of the other two management systems. The reference

system depicts the smallest ratio value, consequently representing the system with the highest DOC fraction per total C in its soils. As previously shown in Figure 14 and in Figure 15, the reference system indeed contains the highest amount of both, DOC and OC. Still, put in proportion to the total C, which contains the inorganic part as well, it clearly shows the smallest ratio which is shown in Figure 16. This can be explained only through the fact, that the standard system on average contains more inorganic C than both other systems, and simultaneously the least DOC and OC.

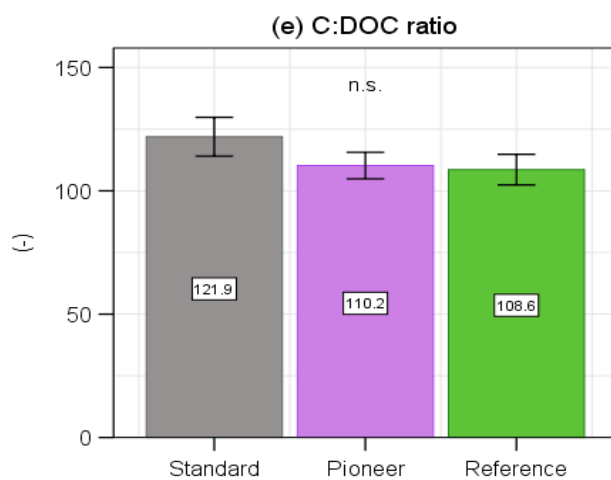


Figure 16: Here the mean C to DOC ratio of the three systems is shown. The standard system represents the highest value: 121.9, meaning those soils have the most C per DOC unit or, expressed in another way, have the least DOC per unit C. The pioneer system has got a mean value of 110.2 and the reference systems value is at 108.6 the lowest of the three compared systems. This results in the assumption that the reference soils have the most DOC in relation to total C, as containing the highest amount of OM and thus OC compared to the total C.

5.2.2 Total N to OC Ratio

In Figure 17 the ratio between the total N and the OC is depicted. As can be seen on the graph, the three different systems show distinct correlations between the total N and the OC content of their soils. The biggest spikes are present in the standard system, especially in terms of N content, given the nature of standardized agricultural management systems artificially fertilizing their crops. The neatest grouping can be found in the pioneer system, which can be confirmed by the statistical analysis of the gained values. The biggest Pearson correlation coefficient is found to be 0.824 with a very high significance ($p < 0.0001$, 2-tailed), and is present in the pioneer system. The reference system shows a Pearson correlation coefficient of 0.542, at a very high significance too. The correlation between the two parameters therefore is

quite a bit lower than in the pioneer system, which is why the graph clearly shows a more scattered pattern through its values. However, the Reference is in the middle, given the results, which clearly show that the standard system has the lowest correlation between the total N and the OC content, i.e. 0.442. In result the spikes in ratio are most notable in the standard system and the scattering generally seems to be more ample as well. In the upper right corner of Figure 17, the coefficients of determination are shown for each system, which in the case of a simple linear regression corresponds the afore-mentioned Pearson correlation coefficients squared.

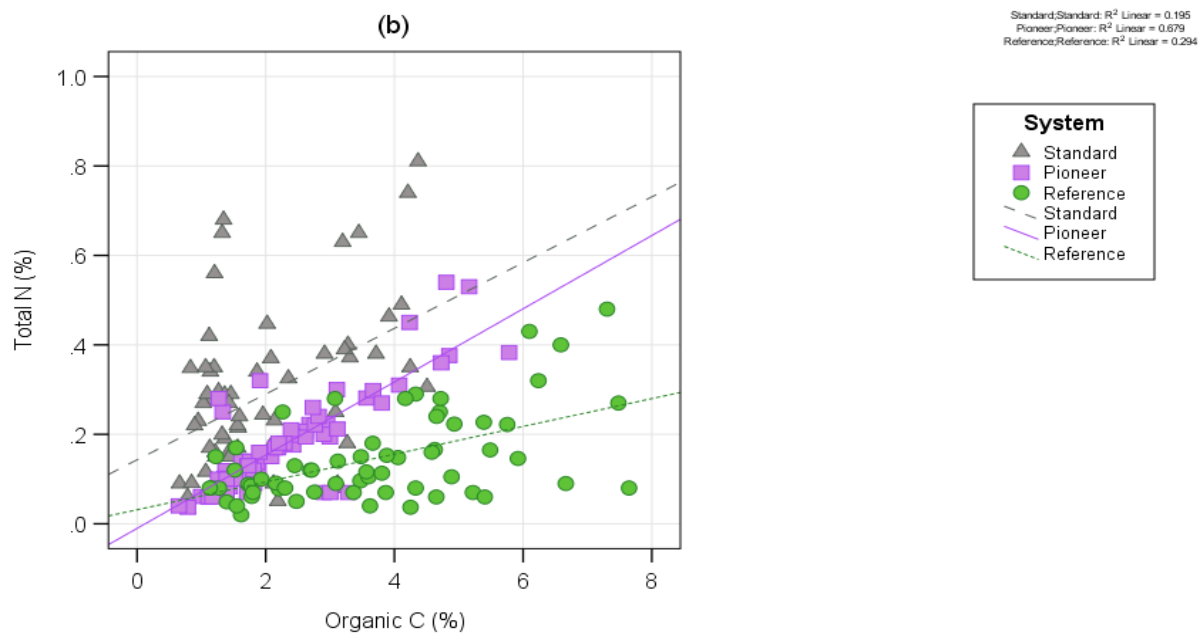


Figure 17: In this graph the total N to OC ratio is represented. Also, linear functions are drawn to show the trend of the different management systems. As can be noted, the reference system is still far away, in terms of trend, even compared to the pioneer system. But at least a distinguishable difference between the standard and the pioneer system can be noted. Further it may be interesting to point out the variance of the pioneer management sites is considerably smaller than the one of the standard management system sites.

5.3 Noteworthy correlations

In the pioneer system some statistical correlations worthy of being mentioned were found. Such as the highly significant negative correlation between the silt fraction and the aggregate stability of a soil. On the other hand, the sand fraction even seems to have a positive effect on the aggregate stability, as the also highly significant correlation between the two indicators of 0.397 shows. Which leads to the suggestions, that silt may in fact be the weak link in the formation of soil aggregates. Another important correlation can be seen in the relation between the EC and the pH value in the pioneer systems. The correlation is of 0.602 and highly significant as well. Further, a negative correlation of -0.505 is to be found between the sand fraction and the

CEC of the pioneer soils, which does not come as a surprise, given the specific surface area of the mentioned fraction and therefore its potential of binding ions on its charged surface sites. Looking at the more interesting parameters for this work, a great correlation of 0.824 between the SOC and the total N is found to be highly significant as well. Another interesting correlation with SOC, is the one between aggregate stability. It is about 0.667 and highly significant as well.

In the standard soils different correlations are found, such as the one between the clay fraction and the EC value, which is about 0.632 and naturally highly significant. Comparing it to the correlation of the same indicators but of the pioneer soils, it is notably higher in the standard system. This leads to the assumption that in order to gain a high EC the standard system relies rather on the clay content of the soil, than on the presence of elevated ion concentrations, such as most nutrients from e.g., organic input. The reference system on the other hand, lies somewhere in between with a correlation value of 0.534. Coming back to the standard system, a similar correlation between the SOC and the aggregate stability can be seen, as the value of 0.623 sits quite close to the 0.667 found in the pioneer system. Nevertheless, the relation between the SOC and the DOC only seems to be correlating only about half as much as in the pioneer system, which could be seen as an indicator for the verification of the second hypothesis, that the DOC is in fact a more sensitive indicator. The correlation here is only about 0.307, although it must be added the p value of < 0.05 is only less significant than the ones mentioned hitherto. Whereas the highly significant ($p < 0.01$) correlation between the same parameters in the pioneer, were to be found at 0.659. Also, of interest is the observation that can be made regarding the difference of the correlation coefficient between the total N and the SOC, which in the pioneer systems is 0.824 and in the standard system a relatively lower 0.442. The situation is very similar to the one found in the correlations between the total N and the DOC of both systems. Once again, the pioneer system soils showing with 0.564 a more important relation between the two parameters than the standard system soils with a mediocre 0.275. This behavior results in the theory that in the standard management systems much more synthetic N is added through intensified fertilization versus the total N in the pioneer management system only coming from the organic input and the natural fixation with the help of soil microbes, therefore being more similar to the accumulation of SOC. In contrast, there is a bigger accumulation of N happening faster than the accumulated SOC, which is lagging behind in the standard system soils.

The higher correlation coefficients in the data gained from the reference system soils, are to be found between the SOC and the DOC, and SOC and the aggregate stability, with values of

0.618 and 0.673 respectively. These values were very similar to the ones found in the pioneer system, with 0.659 and 0.667. This could be seen as potential evidence for the verification of the first hypothesis of this work, that the pioneer systems in fact do approximate the reference systems, in terms of behavior and relation of chosen parameters, especially regarding the OC.

6 Discussion

In this chapter the results will be confronted and put into perspective regarding the initially stated hypotheses. A verification of the hypotheses is aimed for, a falsification is though possible and will as such be thoroughly explained in this chapter.

- H1) Pioneer management systems approximate the SOC storage potential of permanently vegetation covered (semi) natural reference soils, closing the SOC storage deficit of current standard management systems.
- H2) DOC provides a more sensitive indicator for management differences compared to SOC.
- H3) SOC quality indicators (C/N) reflect the distinct SOC stabilization mechanisms due to differences in site specific soil properties (clay content, iron oxides, pH, CEC, Ca⁺⁺).

The first hypothesis established, is about the ability of the pioneer systems to approximate the SOC content of the semi natural reference systems. This is the first hypothesis being set, as it shows if the management measures taken by the agriculturists have the desired outcome regarding the diminution of OC loss from comparable current standard systems. In order to discuss the validity of this hypothesis, a few key parameters can be taken into consideration, such as the SOC and the DOC.

6.1 DOC

Together with the DOC the total OC may be seen as the two most important indicators regarding the hypotheses established for this thesis. It is the crucial parameter to validate if the change of agricultural system from standard to pioneer does in fact prove an increased carbon stock and would thus contribute to a GHG emission mitigation and therefore represent a climate friendly way of practicing agriculture. The ability of soils to store OC is vital for most of the ecological functions that the soil provides. Thus, biomass production, storage and filtration of water and nutrients, and habitat for soil fauna are all strongly affected by OC storage capacity of a soil. However, the reason this paper focuses on the OC stocks of different cropland management systems, is because the relevance of certain agricultural measures on GHG mitigation should be depicted. Many of the parameters shown so far, may be seen as indicators for OC storage capacities for the individual system and soil. In order to validate the assumptions regarding the

OC content made upon these indicators so far must be proven directly, which is why the OC content is ultimately analyzed.

The DOC is an important key player in the soil environment for the following reasons: it leaches quite easily in deeper horizons of the soil profile; it can be transported by erosion; its low molecular weight components may inhibit or accelerate plant growth; it is an energetic fraction easily available to microbes. In soils of cultivated land, the DOC content strongly depends on agrotechnical measures, but most importantly is the quantity and quality of OM input. The adding of fresh OM onto the soil will always increase DOC quantities. Especially the DOC present in the upper most horizon of the soil strongly depends on the fertilizer used on the arable land. This effect may be neglected for soil layers deeper than 50 *cm*, as the literature suggests. However, the pure amount of DOC increases with depth of the soil. That is because of its ability to leach easily, inherent to the character of a dissolved matter and therefore being transported by water, as well as being less susceptible to mineralization. This leads to a higher percentage of DOC of the total OM present in the deeper layers. Nonetheless, a direct impact of agricultural practices such as crop rotation on the enrichment of DOC in the upper soil layers, is proven to be valid by many experts as shown in various works (Gonet & Debska, 2006).

The DOC represents the most mobile fraction of OM present in soils. The amount of DOC found through analyses in a soil sample, may depend on used extraction method itself. (Gonet & Debska, 2006). The DOC functions as a nutrient and energy source for microbes in aquatic environments. Because it can have various forms and sizes, and represents a quite complex structure and thus can attach several different functional groups, it is seen as an important key player in terms of binding metals and organic pollutants (Li & Hur, 2017).

As the DOC has the above-mentioned properties, it acts as the link between the soil and other ecosystems in terms of OC mobilization and thus transportation to other environments e.g., riverine systems. DOC is laboratory-technically defined as the fraction of the OC that can pass a 0.45 μm membrane filter. However, it can be composed of a wide variety of molecules, such as sugars, lipids, simple amino acids up to complex organic compounds showing high molecular weight. These organic substances can be of autochthonous or allochthonous origin, meaning they are either products of microbial activity from within the system, or they originate from the organic input added to the soil. Furthermore, the autochthonous fraction of the DOC molecules, may also be produced by plants and be introduced to the ground through root exudates. Generally, it can be stated that, the bigger the DOC molecules, the slower their diffusion rate and the greater the attraction to sorption sites. Consequently the smaller DOC molecules, are

more mobile as they show greater diffusion and less affinity to any sorption site (Schomakers, Mentler, & Mayer, 2014; van den Berg, Shotbolt, & Ashmore, 2012).

As can be seen in the above-mentioned results, the pioneer system contains significantly more DOC than the standard management system, and therefore approximates the reference system. Looking at the correlation coefficients between the single parameters, the assumption that the second hypothesis may be verified as well. The results gained suggest, that the DOC is a more sensitive indicator than the SOC, given the mentioned differences in correlations between the systems.

6.2 Aggregate stability and OM

However, since this work focuses on SOC, the importance of aggregate stability in terms of OM shall be explained. The relation between OM and mineral particles in aggregates is advantageous for both, as the OM binds minerals and thus minimizes the risk of leaching and slaking, on the other hand the mineral fraction encloses the OM and therefore reduces the exposure to decomposition of the organic particles. The latter is especially proven to be right under grassland or reduced tillage systems, which are both systems that are looked at in this work. The here chosen reference systems, in most cases is actual grassland, and the reduced tillage system may resemble the here chosen pioneer system. Even if reduced tillage only represents one of the measures included by agriculturists in their management strategy in order to become a pioneer system. The management practices in standard agriculture decrease aggregate stability, which is perfectly proven in the gained data. Since the aggregate stability enhances OM persistence as well, the above shown results may be seen as an indicator for the reference systems containing the highest levels of OM and the pioneer systems definitely containing more than the standard agricultural systems, which represent the lowest aggregate stability, OM content and therefore soil structure (Papadopoulos, 2011).

The close correlation coefficients of 0.623, 0.667 and 0.673 of the aggregate stability and the OC show a similar behavior in the systems standard, pioneer and reference respectively. Whereas, looking at the correlation coefficient between the aggregate stability and the DOC, it becomes much clearer that there is a difference of the impact on the OC stock between the systems as well. The standard system having the lowest correlation with 0.264, followed by the pioneer system with a more than twice as high correlation of 0.544, approximating right next to the reference system: 0.659.

6.3 Soil pH

Bacteria and fungi are the main groups of soil microorganisms involved in the decomposition of OM and the turnover of SOC. As such they are very sensitive in terms of pH changes, which makes the soil pH an important dimension indirectly affecting SOC quality and quantity. Among all the chemical, physical and biological soil characteristics, the pH is recognized to be the one influencing microbial decomposition activity the most. A low pH is found to be responsible for decreasing bacterial populations and increasing fungal ones. Resulting in acidic soils depending on fungal activity for SOC turnover and alkaline or neutral soils rather having available bacteria as their main decomposers. Thus, the addition of external Ca-rich material to the soil (liming) is known for boosting SOC mineralization, as increasing the respiration rates of the bacterial microbes. Consequently, changes in management system on cultivated land, which influence the pH as well, have an impact on the microbe composition and their behavior regarding SOC handling (Xiao et al., 2018; Zhang et al., 2021).

Mineral and nutrient solubility in soils is greatly influenced by the pH. For a plant to use the nutrients from the soil, they must be mineralized and dissolved in the solution first. That is when the pH plays a role, as more nutrients go in solution in slightly acidic soils compared to neutral or even alkaline soils. On the other hand, the pH should not be too acidic either, as there might be higher concentrations of Al, Fe and Mn in the solution, which can be toxic to some plants if exceeding certain boundaries. Phosphorus is best available to plants at a pH of about 6.5, together with the other factors this suggests, that the best pH in terms of nutrients availability for plants is between 6 and 7. Of course the pH level also strongly depends on the individual plant preferences, as there are some which prefer acidic soils over alkaline and vice versa. However, an acidic pH may hinder the activity of decomposers and thus influences the SOC content. Leading to a possible accumulation of OM, which may sound preferable in terms of carbon sequestration, but it obviously keeps the decomposing microorganisms from mineralizing other important chemical compounds, such as a variety of nutrients as well (Bickelhaupt, s.a.).

6.4 Total N

Nitrogen (N) often is a limiting nutrient in ecosystems and can be found in both forms in soils: organic and inorganic. The organic part of N in soils occurs in all the different groups and stadiums of OM and the inorganic one mostly appears as ammonium (NH_4) and nitrate (NO_3). The latter forms of N are both assimilable by plants and they are transformed into these compounds after the chemical processes of ammonification and nitrification taking place in the

soil environment. While OM decomposes, N gets released, this happens at a higher rate in warm and humid climates than in cold and dry ones. Furthermore, the release of N is also dependant on how well aeriated the soil is, thus happening quite a bit slower in wet saturated soils. Additionally, to the oxygen levels, the electrical conductivity (EC), the rainfall, and the temperature affect the mineralization rate of N. It also plays an important role in the C cycle, and its gaseous forms have a big GHG potential, which makes it a key player in terms of climate change research. On the other hand, the transformation and mineralization of N is strongly temperature dependent, because it is mostly affected by microbial activity. As mentioned in previous chapters, soil microbes are rather temperature sensitive, that is why increasing mean temperatures above a certain level will inhibit N mineralization. These are the main reasons why it is important to analyse N quantity, as an indicator for soils in such research works as the one at hand (Carbutt, Edwards, Fynn, & Beckett, 2013; Hu et al., 2020; USDA-NRCS, 2017). In a natural ecosystem, such as the reference system chosen here, N is added to the soil by fixation of atmospheric dinitrogen (N_2) from soil bacteria and legumes or through atmospheric deposition in rainfall. In cultivated systems, such as the pioneer and standard management system, N is typically added by fertilizers, manure or other organic material. The percentage values of total N gained in the analyses reflects the usage of additional N in cultivated systems.

6.5 EC

Electrical conductivity (EC) is an intrinsic property of the material present in soils itself and it gives information about the ability of a soil to conduct electrical charges. Generally speaking, clay possesses a greater conductivity potential than sand and silt, given that the specific surface area of clay with $7.4 * 10^6 \text{ cm}^2/\text{g}$ is much larger compared to the one of silt with $11.1 * 10^4 \text{ cm}^2/\text{g}$ or sand with $444.4 \text{ cm}^2/\text{g}$. This results from clay having more particle-to-particle contact, and thus being able to conduct the electrical charge at a broader scale of directions. If this physical property is measure on the field, there may be a blurring of the results gained, due to different moisture contents on the field and also due to the individual water retention capacities of the different soil texture classes. Naturally, a wetted soil or a wetted texture will show a higher EC value than a dry one. Since the analyses for this work have all been conducted in the laboratory, there are standardized procedures for eliminating these advantages in order to make the gained results comparable (Lund, 2015).

In terms of cultivated land, the soil EC can be seen as an indicator for the soil health, as the salinity of a soil is measured. The amount of salt in a soil influences the crop yield, the crop suitability and the plant nutrient availability. The soil-water-balance is affected by the salt

content and too much of it hinders plant growth altogether. Moreover, the EC can be interpreted as a proxy for the quantity of a variety of ions as well, because if solved in water they will enhance the EC. Concentrations of ions such as potassium, nitrates, sodium, chlorides and sulfate are found to be strongly correlated to the measured EC of a soil. Additionally, the EC is strongly affected by the land use itself and management measures such as irrigation, application of fertilizer, manure, and compost. On cultivated land, low organic matter input, poor infiltration and drainage, or compaction can lead to an increased salinity level and thus a high EC (Barbosa, R.N., & Overstreet, 2011; USDA, 2011).

Here the reference system appears to have the highest EC, as no management measures are taken to hinder an accumulation of ions and thus salt. Following the statistics that have been made for interpreting the results of this work, the EC for the reference system strongly positively correlates with the clay present in a sample, it even stronger correlates with the pH though and with the organic C measured and the cation exchange capacity (CEC) as well. These correlations were found with the use of Pearson correlation coefficients, and are all very significant as lying below the 0.01 level of p. Of course, when examining the correlation between the EC and the sand content, the test produced a very significant and strong negative Pearson correlation coefficient, therefore underlining the above-mentioned influence of the clay content on the EC.

7 Conclusion

Concluding it can be stated, that with the use of the here gained results the soils of the pioneer management system, dispose of significantly more SOC, than the comparable standard management system. Further, the DOC provides a more sensitive indicator for the effects of management system change, particularly under the light of the emerging views on SOC and its forms in modern soil sciences. On the other hand, there is still a noticeable gap between the quantity and quality of SOC, DOC and further quality indicators in the soils of the pioneer management systems and the corresponding ones of the reference systems. An approximation towards the natural level can be interpreted from the results gained, even if the changeover time was relatively short (minimum limit since management change has been set as 6 years). Consequently, more research in the field of measurable SOC indicators from changes in agricultural management methods is needed, mainly under the premise of a management-measure-mix such as it has been chosen for this research project.

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9 Annex

Correlations^a

	CLAY	SILT	SAND	Oxalat_Oxides	pH	EC	CEC	Org	Ntot	solC/Nratio	DOC	AGGSTAB	C_DOC_ratio
CLAY	Pearson Correlation	1	0.163	-.655 ^{**}	.391 ^{**}	.349 ^{**}	.458 ^{**}	0.201	-0.055	.422 ^{**}	-.284 ^{**}	0.208	.536 ^{**}
	Sig. (2-tailed)		0.201	0.000	0.659	0.005	0.000	0.113	0.671	0.001	0.037	0.102	0.00001
	N	63	63	63	63	63	63	63	63	63	63	63	63
SILT	Pearson Correlation	0.163	1	-.852 ^{**}	0.184	0.239	.343 ^{**}	-.425 ^{**}	-0.223	-0.126	-.401 ^{**}	-.663 ^{**}	-0.214
	Sig. (2-tailed)	0.201		0.000	0.411	0.059	0.006	0.001	0.079	0.324	0.001	0.000	0.092
	N	63	63	63	63	63	63	63	63	63	63	63	63
SAND	Pearson Correlation	-.655 ^{**}	1	-.368 ^{**}	-.348 ^{**}	-.368 ^{**}	-.505 ^{**}	0.219	0.200	-0.127	.447 ^{**}	.397 ^{**}	-0.120
	Sig. (2-tailed)	0.000	0.000	0.388	0.005	0.003	0.000	0.085	0.117	0.322	0.000	0.001	0.349
	N	63	63	63	63	63	63	63	63	63	63	63	63
Oxalat_Oxides	Pearson Correlation	0.057	0.105	-0.111	1	-0.093	0.101	0.105	.367 ^{**}	.332 ^{**}	.343 ^{**}	0.231	0.129
	Sig. (2-tailed)	0.659	0.411	0.388	0.468	0.431	0.413	0.003	0.008	0.834	0.006	0.069	0.315
	N	63	63	63	63	63	63	63	63	63	63	63	63
pH	Pearson Correlation	.391 ^{**}	0.184	-.348 ^{**}	1	.602 ^{**}	.570 ^{**}	0.148	0.199	0.056	-0.046	-0.119	0.223
	Sig. (2-tailed)	0.002	0.148	0.005	0.468	0.000	0.000	0.249	0.118	0.665	0.720	0.353	0.078
	N	63	63	63	63	63	63	63	63	63	63	63	63
EC	Pearson Correlation	.349 ^{**}	0.239	-.368 ^{**}	0.101	.602 ^{**}	.570 ^{**}	0.148	0.199	0.056	-0.046	-0.119	0.223
	Sig. (2-tailed)	0.005	0.059	0.003	0.431	0.000	0.000	0.001	0.001	0.791	0.192	0.973	0.005
	N	63	63	63	63	63	63	63	63	63	63	63	63
CEC	Pearson Correlation	.458 ^{**}	.343 ^{**}	-.505 ^{**}	0.105	.531 ^{**}	1	.254 ^{**}	.537 ^{**}	-.401 ^{**}	-0.117	-0.146	.397 ^{**}
	Sig. (2-tailed)	0.000	0.006	0.000	0.413	0.000	0.000	0.045	0.000	0.001	0.363	0.253	0.001
	N	63	63	63	63	63	63	63	63	63	63	63	63
Org	Pearson Correlation	0.201	-.425 ^{**}	0.219	.367 ^{**}	.415 ^{**}	.254 ^{**}	1	.824 ^{**}	-0.015	.659 ^{**}	.667 ^{**}	.660 ^{**}
	Sig. (2-tailed)	0.113	0.001	0.085	0.003	0.249	0.001	0.045	0.000	0.908	0.000	0.000	0.000
	N	63	63	63	63	63	63	63	63	63	63	63	63
Ntot	Pearson Correlation	-0.055	-0.223	0.200	.332 ^{**}	0.199	.405 ^{**}	.824 ^{**}	1	-.482 ^{**}	.564 ^{**}	.368 ^{**}	.489 ^{**}
	Sig. (2-tailed)	0.671	0.079	0.117	0.008	0.118	0.001	0.000	0.000	0.000	0.000	0.003	0.000
	N	63	63	63	63	63	63	63	63	63	63	63	63
solC/Nratio	Pearson Correlation	.422 ^{**}	-0.126	-0.127	0.027	0.056	-0.034	-.401 ^{**}	-0.015	-.482 ^{**}	1	-0.165	0.245
	Sig. (2-tailed)	0.001	0.324	0.322	0.834	0.665	0.791	0.001	0.908	0.000	0.198	0.053	0.124
	N	63	63	63	63	63	63	63	63	63	63	63	63
DOC	Pearson Correlation	-.284 ^{**}	-.401 ^{**}	.447 ^{**}	.343 ^{**}	-0.046	0.166	-0.117	.659 ^{**}	-.0165	1	.544 ^{**}	-0.093
	Sig. (2-tailed)	0.037	0.001	0.000	0.006	0.720	0.192	0.363	0.000	0.000	0.198	0.000	0.471
	N	63	63	63	63	63	63	63	63	63	63	63	63
AGGSTAB	Pearson Correlation	0.208	-.663 ^{**}	.397 ^{**}	0.231	-0.119	-0.004	-0.146	.667 ^{**}	.368 ^{**}	.245	.544 ^{**}	1
	Sig. (2-tailed)	0.102	0.000	0.001	0.069	0.353	0.973	0.253	0.000	0.003	0.053	0.000	0.001
	N	63	63	63	63	63	63	63	63	63	63	63	63
C_DOC_ratio	Pearson Correlation	.536 ^{**}	-0.214	-0.120	0.129	0.223	.350 ^{**}	.660 ^{**}	.489 ^{**}	0.196	-0.093	.415 ^{**}	1
	Sig. (2-tailed)	0.000	0.092	0.349	0.315	0.078	0.005	0.001	0.000	0.124	0.471	0.001	
	N	63	63	63	63	63	63	63	63	63	63	63	63

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

a. System = Pioneer

Correlations^a

	CLAY	SILT	SAND	Oxalat_Oxides	pH	EC	CEC	Corg	Ntot	solC/Nratio	DOC	AGGSTAB	C_DOC_ratio
Pearson Correlation	1	.268 ^{**}	-.713 ^{**}	-.0104	.548 ^{**}	.632 ^{**}	-.387 ^{**}	.327 ^{**}	-.071 ^{**}	.278 ^{**}	-.0147	.254 [*]	.389 ^{**}
Sig. (2-tailed)		0.034	0.000	0.419	0.000	0.000	0.002	0.009	0.579	0.027	0.251	0.044	0.002
N	63	63	63	63	63	63	63	63	63	63	63	63	63
Pearson Correlation	.268 ^{**}	1	-.866 ^{**}	0.155	.305 [*]	.363 ^{**}	.316 ^{**}	-.232	0.001	-.087	-.0130	-.503 ^{**}	-.245
Sig. (2-tailed)	0.034		0.000	0.224	0.015	0.003	0.012	0.067	0.996	0.499	0.311	0.000	0.053
N	63	63	63	63	63	63	63	63	63	63	63	63	63
Pearson Correlation	-.713 ^{**}	-.866 ^{**}	1	-.059	-.506 ^{**}	-.592 ^{**}	-.431 ^{**}	-.001	0.037	-.081	0.171	0.234	-.024
Sig. (2-tailed)	0.000	0.000		0.645	0.000	0.000	0.000	0.995	0.776	0.526	0.182	0.065	0.855
N	63	63	63	63	63	63	63	63	63	63	63	63	63
Pearson Correlation	-.0104	0.155	-.059	1	-.190	-.047	-.047	0.070	0.229	0.040	-.038	0.135	0.115
Sig. (2-tailed)	0.419	0.224	0.645		0.136	0.242	0.714	0.588	0.071	0.753	0.765	0.293	0.370
N	63	63	63	63	63	63	63	63	63	63	63	63	63
Pearson Correlation	.548 ^{**}	.305 [*]	-.506 ^{**}	-.0190	1	.709 ^{**}	.599 ^{**}	0.236	0.151	-.020	-.253 [*]	-.0147	.314 ^{**}
Sig. (2-tailed)	0.000	0.015	0.000	0.136		0.000	0.000	0.062	0.237	0.877	0.045	0.250	0.012
N	63	63	63	63	63	63	63	63	63	63	63	63	63
Pearson Correlation	.632 ^{**}	.363 ^{**}	-.592 ^{**}	-.0150	.709 ^{**}	1	.620 ^{**}	.517 ^{**}	0.132	0.194	0.096	0.139	.393 ^{**}
Sig. (2-tailed)	0.000	0.003	0.000	0.242	0.000		0.000	0.000	0.303	0.128	0.452	0.279	0.001
N	63	63	63	63	63	63	63	63	63	63	63	63	63
Pearson Correlation	.387 ^{**}	.316 [*]	-.431 ^{**}	-.0047	.599 ^{**}	.620 ^{**}	1	.301 [*]	.537 ^{**}	-.262 [*]	-.033	-.073	.252 [*]
Sig. (2-tailed)	0.002	0.012	0.000	0.714	0.000	0.000		0.017	0.000	0.038	0.797	0.569	0.046
N	63	63	63	63	63	63	63	63	63	63	63	63	63
Pearson Correlation	.327 ^{**}	-.0232	-.001	0.070	0.236	.517 ^{**}	.301 [*]	1	.442 ^{**}	.261 [*]	.307 ^{**}	.623 ^{**}	.845 ^{**}
Sig. (2-tailed)	0.009	0.067	0.995	0.588	0.062	0.000	0.017		0.000	0.039	0.014	0.000	0.000
N	63	63	63	63	63	63	63	63	63	63	63	63	63
Pearson Correlation	-.071	0.001	0.037	0.229	0.151	0.132	.537 ^{**}	.442 ^{**}	1	-.526 ^{**}	.275 [*]	0.148	.310 [*]
Sig. (2-tailed)	0.579	0.996	0.776	0.071	0.237	0.303	0.000	0.000		0.000	0.029	0.246	0.013
N	63	63	63	63	63	63	63	63	63	63	63	63	63
Pearson Correlation	.278 [*]	-.087	-.081	0.040	-.020	0.194	-.262 [*]	.261 [*]	-.526 ^{**}	1	-.025	.261 [*]	.254 [*]
Sig. (2-tailed)	0.027	0.499	0.526	0.753	0.877	0.128	0.038	0.039	0.000		0.846	0.039	0.044
N	63	63	63	63	63	63	63	63	63	63	63	63	63
Pearson Correlation	-.0147	-.0130	0.171	-.038	-.253 [*]	0.096	-.033	.307 [*]	.275 [*]	-.025	1	.264 [*]	-.0169
Sig. (2-tailed)	0.251	0.311	0.182	0.765	0.045	0.452	0.797	0.014	0.029	0.846		0.037	0.186
N	63	63	63	63	63	63	63	63	63	63	63	63	63
Pearson Correlation	.254 [*]	-.503 ^{**}	0.234	0.135	-.0147	0.139	-.073	.623 ^{**}	0.148	.261 [*]	.264 [*]	1	.560 ^{**}
Sig. (2-tailed)	0.044	0.000	0.065	0.293	0.250	0.279	0.569	0.000	0.246	0.039	0.037		0.000
N	63	63	63	63	63	63	63	63	63	63	63	63	63
Pearson Correlation	.389 ^{**}	-.0245	-.024	0.115	.314 [*]	.393 ^{**}	.252 [*]	.845 ^{**}	.310 [*]	.254 [*]	-.0169	.560 ^{**}	1
Sig. (2-tailed)	0.002	0.053	0.855	0.370	0.012	0.001	0.046	0.000	0.013	0.044	0.186	0.000	
N	63	63	63	63	63	63	63	63	63	63	63	63	63

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

a. System = Standard

Correlations^a

	CLAY	SILT	SAND	Oxalat_Oxides	pH	EC	CEC	Corg	Ntot	soilCNRatio	DOC	AGGSTAB	C_DOC_ratio
CLAY	Pearson Correlation	1	0.206	-0.639	0.194	.527	.534	.463	.266	0.066	0.093	0.048	.277
	Sig. (2-tailed)		0.104	0.000	0.128	0.000	0.000	0.037	0.609	0.472	0.710	0.987	0.029
	N	63	63	63	63	63	63	62	63	62	62	63	62
SILT	Pearson Correlation	0.206	1	-0.884	0.124	.435	0.222	.349	-.331	-0.101	-0.232	-0.184	-0.223
	Sig. (2-tailed)	0.104	0.000	0.000	0.332	0.000	0.081	0.005	0.009	0.430	0.070	0.153	0.082
	N	63	63	63	63	63	63	62	63	62	62	63	62
SAND	Pearson Correlation	-0.639	-0.884	1	-0.190	-.593	-.429	-.495	0.131	0.048	0.136	0.120	.437
	Sig. (2-tailed)	0.000	0.000	0.000	0.135	0.000	0.000	0.000	0.310	0.708	0.290	0.351	0.041
	N	63	63	63	63	63	63	62	63	62	62	63	0.751
Oxalat_Oxides	Pearson Correlation	0.194	0.124	-0.190	1	-0.128	-0.122	0.161	0.228	.308	-0.138	0.069	0.172
	Sig. (2-tailed)	0.128	0.332	0.135		0.325	0.339	0.209	0.075	0.014	0.284	0.596	0.177
	N	63	63	63	63	63	63	63	62	63	62	62	0.048
pH	Pearson Correlation	.527	.435	-.593	-0.126	1	.696	.446	0.096	0.049	0.089	-0.160	0.183
	Sig. (2-tailed)	0.000	0.000	0.000	0.325		0.000	0.000	0.459	0.701	0.493	0.214	0.155
	N	63	63	63	63	63	63	62	63	62	62	63	62
EC	Pearson Correlation	.534	0.222	-.429	-0.122	.696	1	.539	.568	.284	0.215	.344	.342
	Sig. (2-tailed)	0.000	0.081	0.000	0.339	0.000		0.000	0.000	0.024	0.093	0.006	0.006
	N	63	63	63	63	63	63	62	63	63	62	62	63
CEC	Pearson Correlation	.463	.349	-.495	0.161	.446	.539	1	.315	.599	-.382	0.165	.281
	Sig. (2-tailed)	0.000	0.005	0.000	0.209	0.000	0.000	0.013	0.013	0.000	0.002	0.201	0.041
	N	63	63	63	63	63	63	62	63	62	62	63	62
Corg	Pearson Correlation	.266	-.331	0.131	0.228	0.096	.568	.315	1	.542	.281	.618	.643
	Sig. (2-tailed)	0.037	0.009	0.310	0.075	0.459	0.000	0.013		0.000	0.027	0.000	0.000
	N	62	62	62	62	62	62	62	62	62	62	62	62
Ntot	Pearson Correlation	0.066	-0.101	0.048	.308	0.049	.284	.599	.542	1	-.516	.363	.339
	Sig. (2-tailed)	0.609	0.430	0.708	0.014	0.701	0.024	0.000	0.000		0.000	0.004	0.007
	N	63	63	63	63	63	63	63	62	63	62	63	62
soilCNRatio	Pearson Correlation	0.093	-0.232	0.136	-0.138	0.089	0.215	-.382	.281	-.516	1	0.145	0.149
	Sig. (2-tailed)	0.472	0.070	0.290	0.284	0.493	0.093	0.002	0.027	0.000		0.259	0.249
	N	62	62	62	62	62	62	62	62	62	62	62	62
DOC	Pearson Correlation	0.048	-0.184	0.120	0.069	-0.160	.344	0.165	.618	.363	0.145	1	.659
	Sig. (2-tailed)	0.710	0.153	0.351	0.596	0.214	0.006	0.201	0.000	0.004	0.259		0.000
	N	62	62	62	62	62	62	62	62	62	62	62	0.262
AGGSTAB	Pearson Correlation	0.002	-.357	.437	0.172	-.352	0.166	0.009	.673	.406	0.133	.659	.281
	Sig. (2-tailed)	0.987	0.000	0.000	0.177	0.005	0.193	0.942	0.000	0.001	0.302	0.000	0.027
	N	63	63	63	63	63	63	63	62	63	62	63	62
C_DOC_ratio	Pearson Correlation	.277	-0.223	0.041	.252	0.183	.342	.261	.643	.339	0.149	-0.145	.281
	Sig. (2-tailed)	0.029	0.082	0.751	0.048	0.155	0.006	0.041	0.000	0.007	0.249	0.262	0.027
	N	62	62	62	62	62	62	62	62	62	62	62	62

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. System = Reference

	Longitude	Latitude	System	Soil type (WRB)	CLAY	SILT	SAND	Texture class	pH	EC	WC	CEC	Al_Dithionit	Mn_Dithionit	Fe_Dithionit	Al_Oxalat	Mn_Oxalat	Fe_Oxalat	
Absdorf	48.405609°	15.972181°	Standard	Calcic Phaeozem	51,4	39,9	8,7	ul-IT		7,85	115,7	2,37	276,7	551	345	7398	1344	362	1385
			Pioneer		51,8	39,6	8,6			7,83	130,8	3,61	330,9	794	454	10845	1884	490	2096
Au am Leithagebirge 1	47.931354°	16.528668°	Reference		41,2	36,7	22,2			7,87	180,5	3,50	199,9	808	440	10636	1910	497	2087
			Standard	Calcic Phaeozem	25,6	24,9	49,4	ul-IT		7,97	116,1	1,39	199,9	238	179	3416	564	172	1537
Au am Leithagebirge 2	47.922232°	16.571918°	Pioneer		31,0	27,9	41,1			7,85	139,4	2,13	284,7	359	216	3203	1102	260	1339
			Standard	Leptosol	12,7	22,3	65,0			7,11	164,4	1,87	249,3	353	218	3103	1082	235	1135
Groß Burgstall1 (toeslope)	48.672057°	15.590890°	Pioneer		11,9	20,7	67,4	IS		6,71	38,7	1,06	160,4	454	338	6025	1022	466	2318
			Standard		15,0	20,1	64,9			7,31	85,6	0,77	113,1	340	214	4433	598	305	1640
Groß Burgstall2 (shoulder)	48.672057°	15.590890°	Reference		14,1	20,6	65,3			7,11	102,4	0,62	57,1	453	227	5141	622	293	1609
			Standard	Leptic Cambisol	23,3	27,4	49,3	IS-sL		7,07	65,1	1,49	72,9	607	262	6175	930	284	2838
Eisgarn	48.921815°	15.101040°	Pioneer		19,6	33,0	47,4			7,18	89,9	1,45	142,6	623	362	10003	956	464	2709
			Standard	Leptic Cambisol	14,3	24,0	61,7			6,00	47,1	1,87	170,4	646	430	10484	1042	447	2205
Fischamend	48.095994°	16.648570°	Reference		11,3	23,7	65,0	IS-sL		6,84	54,6	1,14	129,5	303	237	4201	564	326	2047
			Pioneer		14,7	27,3	58,0			7,11	92,1	0,99	109,6	329	265	5027	599	329	2789
Grüßern	48.553441°	15.786040°	Pioneer		11,8	28,4	59,7			7,18	89,9	1,45	142,6	623	362	10003	956	464	2709
			Standard	Chernozem	26,7	60,3	13,0	IU		7,96	123,0	1,53	191,2	615	417	7531	1411	441	1454
Lackendorf1	47.585173°	16.498775°	Pioneer		22,6	57,9	19,5			7,93	166,8	1,49	194,5	582	381	7116	1466	426	1398
			Standard	Chernozem	21,6	59,5	18,9			7,97	148,6	1,84	205,4	785	479	8934	1647	576	1770
Lackendorf2	47.600317°	16.475886°	Pioneer		20,6	59,3	20,0	IU		7,90	123,0	1,51	181,4	647	302	8542	993	263	1379
			Standard		21,7	64,1	14,2			7,95	131,6	1,06	154,2	581	294	7131	1028	295	1501
Mammersdorf1	47.984081°	16.626563°	Pioneer		20,3	63,6	16,1			8,02	150,5	1,18	146,2	556	265	6679	897	236	1313
			Standard	Cambisol	8,4	31,4	60,3	IS		6,13	34,5	1,16	140,3	451	446	4612	861	603	2632
Mammersdorf2	47.990313°	16.564098°	Pioneer		10,0	29,8	60,2			7,33	75,9	0,34	61,3	461	431	3492	771	576	1677
			Standard	Fluvisol	36,8	56,6	6,5	IU		7,54	159,5	0,54	16,1	538	413	3381	662	510	1476
Moosbrunn	47.999589°	16.423164°	Pioneer		30,5	58,9	10,6			7,50	194,5	1,95	300,1	882	448	11030	1863	494	3140
			Standard	Calcic Phaeozem/Chernozem	29,9	44,5	25,7			7,63	177,8	2,25	312,4	861	391	9261	2123	405	2719
Rodingersdorf1	48.684169°	15.721120°	Reference		34,1	49,2	16,7	ul		7,55	178,2	1,98	313,6	339	208	3062	1143	116	1215
			Pioneer		36,8	43,7	19,5			7,77	169,0	1,60	296,7	448	199	3257	1783	113	1456
Rodingersdorf2	48.697358°	15.712501°	Reference		33,6	42,0	24,4			7,48	208,0	1,75	310,2	379	220	3074	1299	136	1355
			Standard	Ferric Stagnosol	11,5	42,9	45,6	sL		6,09	90,2	1,18	103,4	476	393	5498	707	459	2397
Steinabrunn	48.512088°	16.206748°	Pioneer		13,0	45,4	41,7			6,57	117,3	2,59	81,6	482	415	5494	653	492	2091
			Standard	Luvisol	15,3	43,9	40,7			6,51	89,6	0,92	79,3	538	476	5206	815	539	2293
Schachendorf1	47.263076°	16.452471°	Pioneer		30,7	54,5	14,8	IU		6,52	53,9	7,23	152,7	616	515	723	8474	901	539
			Standard	Haplic Regosol (Loess)	27,1	46,9	26,1			7,20	56,7	0,98	150,0	388	262	6071	652	175	915
Schachendorf2	47.266085°	16.418908°	Pioneer		26,1	57,4	16,6			6,82	75,8	1,16	152,7	681	426	8866	1040	520	3363
			Standard	Stagnogleyic - Cambisol	22,9	58,0	19,1			6,97	115,1	1,38	145,7	844	357	10436	1331	475	2895
Stockerau	48.404820°	16.203728°	Reference		30,4	43,1	26,3	su-IU		7,47	102,1	1,70	219,0	395	250	6289	705	180	904
			Pioneer		27,1	46,9	26,1			7,20	56,7	0,98	150,0	388	262	6071	652	175	915
Theresienfeld	47.848853°	16.256196°	Reference		28,7	45,0	26,3			7,85	153,4	0,90	154,4	402	259	6382	783	206	940
			Standard	Chernozem	46,3	41,5	12,3	sl-IU		7,89	169,7	1,30	170,5	874	624	11437	1066	723	4051
Umbach	48.236622°	15.440191°	Pioneer		47,7	37,8	14,6			7,86	146,6	1,15	123,7	854	628	10421	1082	807	3671
			Standard	Calcic Leptosol	47,8	34,8	17,4			7,85	193,5	1,30	159,0	898	648	11848	2522	737	3403
	47.266085°	16.418908°	Reference		20,5	70,4	9,1	ul		7,89	117,2	2,97	401,6	578	526	12249	1263	560	6653
			Pioneer		18,7	72,4	8,9			7,89	130,0	2,84	386,7	749	672	14908	1298	765	4638
	48.404820°	16.203728°	Reference		20,7	71,2	8,1			7,89	162,6	2,90	174,3	756	736	13008	1206	779	5547
			Standard	Chernozem	19,6	59,5	21,0	IU		7,84	118,6	1,09	174,3	637	342	6084	1153	328	1484
	47.848853°	16.256196°	Pioneer		19,7	59,9	20,4			7,76	138,7	1,14	169,2	638	332	6103	1174	319	1457
			Standard	Calcic Leptosol	22,6	58,7	18,8			7,76	145,0	1,03	159,9	656	333	6472	1247	307	1265
	48.236622°	15.440191°	Reference		18,5	24,0	57,5	IS		7,77	112,7	2,27	351,9	680	388	7973	2599	224	1534
			Pioneer		15,6	24,7	59,7			7,79	136,3	1,91	289,5	605	359	6504	2633	164	1481
	48.236622°	15.440191°	Reference		23,2	55,3	7,83			1,61	279,6	648	341	7529	2941	119	1445		
			Standard	Luvisol	67,6	8,3	7,22	ul-ul		1,65	146,0	905	516	10542	1036	584	3058		
	48.236622°	15.440191°	Pioneer		27,6	64,8	7,6			1,52	185,8	1110	556	12958	1186	532	3482		
			Reference		23,6	21,7	7,72			1,36	225,3	1023	613	10820	854	478	2809		

Lab_ID	Sample_ID	Site	System_ID	System	Depth_ID	Depth	CLAY	SILT	SAND	pH	EC	CLAY	FINESILT	MIDDLESILT	COARSESTILT	FINESAND	MIDDLESAND	COARSEAND
994	Abs_P_1 pool	Absdorf	Pioneer	2	2,5	1	51,841	39,585	8,574	7,826	139,700	51,841	15,441	11,922	12,222	6,506	1,455	0,614
995	Abs_P_2 pool	Absdorf	Pioneer	2	7,5	1	51,841	39,585	8,574	7,785	126,800	51,841	15,441	11,922	12,222	6,506	1,455	0,614
996	Abs_P_3 pool	Absdorf	Pioneer	2	27,5	3	51,841	39,585	8,574	7,865	125,800	51,841	15,441	11,922	12,222	6,506	1,455	0,614
997	Abs_St_1 pool	Absdorf	Reference	3	2,5	1	41,155	36,681	22,164	7,860	203,000	41,155	13,246	13,246	10,189	15,160	5,527	1,477
998	Abs_St_2 pool	Absdorf	Reference	3	7,5	2	41,155	36,681	22,164	7,915	177,400	41,155	13,246	13,246	10,189	15,160	5,527	1,477
999	Abs_St_3 pool	Absdorf	Reference	3	27,5	3	41,155	36,681	22,164	7,839	161,100	41,155	13,246	13,246	10,189	15,160	5,527	1,477
1000	Abs_Ref_1 pool	Absdorf	Standard	1	2,5	1	51,384	39,872	8,744	7,840	113,500	51,384	13,209	16,058	10,605	7,235	1,349	0,159
1001	Abs_Ref_2 pool	Absdorf	Standard	1	7,5	2	51,384	39,872	8,744	7,850	116,500	51,384	13,209	16,058	10,605	7,235	1,349	0,159
1002	Abs_Ref_3 pool	Absdorf	Standard	1	27,5	3	51,384	39,872	8,744	7,870	117,200	51,384	13,209	16,058	10,605	7,235	1,349	0,159
1003	Au1_P_1 pool	Au1	Pioneer	2	2,5	1	31,013	27,917	41,069	7,773	147,700	31,013	6,309	11,133	10,476	15,366	14,618	11,086
1004	Au1_P_2 pool	Au1	Pioneer	2	7,5	2	31,013	27,917	41,069	7,858	138,800	31,013	6,309	11,133	10,476	15,366	14,618	11,086
1005	Au1_P_3 pool	Au1	Pioneer	2	27,5	3	31,013	27,917	41,069	7,911	131,800	31,013	6,309	11,133	10,476	15,366	14,618	11,086
1006	Au1_St_1 pool	Au1	Reference	3	2,5	1	12,687	22,321	64,992	7,180	175,000	12,687	4,792	6,480	11,050	22,257	27,280	15,455
1007	Au1_St_2 pool	Au1	Reference	3	7,5	2	12,687	22,321	64,992	7,044	154,800	12,687	4,792	6,480	11,050	22,257	27,280	15,455
1008	Au1_St_3 pool	Au1	Reference	3	27,5	3	12,687	22,321	64,992	7,107	163,500	12,687	4,792	6,480	11,050	22,257	27,280	15,455
1009	Au1_Ref_1 pool	Au1	Standard	1	2,5	1	25,642	24,935	49,423	7,955	115,200	25,642	6,584	8,886	9,465	15,769	18,007	15,647
1010	Au1_Ref_2 pool	Au1	Standard	1	7,5	2	25,642	24,935	49,423	7,948	113,100	25,642	6,584	8,886	9,465	15,769	18,007	15,647
1011	Au1_Ref_3 pool	Au1	Standard	1	27,5	3	25,642	24,935	49,423	7,996	120,000	25,642	6,584	8,886	9,465	15,769	18,007	15,647
1012	Au2_P_1 pool	Au2	Pioneer	2	2,5	1	14,981	20,071	64,948	7,301	91,200	14,981	1,938	7,386	10,748	27,850	24,563	12,534
1013	Au2_P_2 pool	Au2	Pioneer	2	7,5	2	14,981	20,071	64,948	7,277	83,200	14,981	1,938	7,386	10,748	27,850	24,563	12,534
1014	Au2_P_3 pool	Au2	Pioneer	2	27,5	3	14,981	20,071	64,948	7,365	82,400	14,981	1,938	7,386	10,748	27,850	24,563	12,534
1015	Au2_St_1 pool	Au2	Reference	3	2,5	1	14,117	20,580	65,303	6,976	119,500	14,117	6,791	5,721	8,068	22,238	29,956	13,109
1016	Au2_St_2 pool	Au2	Reference	3	7,5	2	14,117	20,580	65,303	7,075	105,500	14,117	6,791	5,721	8,068	22,238	29,956	13,109
1017	Au2_St_3 pool	Au2	Reference	3	27,5	3	14,117	20,580	65,303	7,284	82,100	14,117	6,791	5,721	8,068	22,238	29,956	13,109
1018	Au2_Ref_1 pool	Au2	Standard	1	2,5	1	11,885	20,694	67,421	6,808	44,800	11,885	2,601	6,019	12,073	26,946	24,239	16,237
1019	Au2_Ref_2 pool	Au2	Standard	1	7,5	2	11,885	20,694	67,421	6,712	35,100	11,885	2,601	6,019	12,073	26,946	24,239	16,237
1020	Au2_Ref_3 pool	Au2	Standard	1	27,5	3	11,885	20,694	67,421	6,606	36,100	11,885	2,601	6,019	12,073	26,946	24,239	16,237
1021	Burg1_P_1 pool	Burg1	Pioneer	2	2,5	1	19,596	33,045	47,359	6,925	103,600	19,596	6,137	7,168	19,740	15,422	21,941	9,996
1022	Burg1_P_2 pool	Burg1	Pioneer	2	7,5	2	19,596	33,045	47,359	7,392	96,000	19,596	6,137	7,168	19,740	15,422	21,941	9,996
1023	Burg1_P_3 pool	Burg1	Pioneer	2	27,5	3	19,596	33,045	47,359	7,220	70,000	19,596	6,137	7,168	19,740	15,422	21,941	9,996
1024	Burg1_St_1 pool	Burg1	Reference	3	2,5	1	14,298	23,968	61,735	6,108	62,000	14,298	3,894	6,509	13,565	23,945	28,385	9,404
1025	Burg1_St_2 pool	Burg1	Reference	3	7,5	2	14,298	23,968	61,735	5,910	43,400	14,298	3,894	6,509	13,565	23,945	28,385	9,404
1026	Burg1_St_3 pool	Burg1	Reference	3	27,5	3	14,298	23,968	61,735	5,979	35,800	14,298	3,894	6,509	13,565	23,945	28,385	9,404
1027	Burg1_Ref_1 pool	Burg1	Standard	1	2,5	1	23,273	27,410	49,317	7,137	70,000	23,273	4,872	7,049	15,490	16,689	21,156	11,471
1028	Burg1_Ref_2 pool	Burg1	Standard	1	7,5	2	23,273	27,410	49,317	6,851	64,100	23,273	4,872	7,049	15,490	16,689	21,156	11,471
1029	Burg1_Ref_3 pool	Burg1	Standard	1	27,5	3	23,273	27,410	49,317	7,210	61,300	23,273	4,872	7,049	15,490	16,689	21,156	11,471
1030	Burg2_P_1 pool	Burg2	Pioneer	2	2,5	1	14,699	27,301	58,000	6,863	101,400	14,699	4,089	8,488	14,724	22,425	25,144	10,431
1031	Burg2_P_2 pool	Burg2	Pioneer	2	7,5	2	14,699	27,301	58,000	7,277	101,400	14,699	4,089	8,488	14,724	22,425	25,144	10,431
1032	Burg2_P_3 pool	Burg2	Pioneer	2	27,5	3	14,699	27,301	58,000	7,201	73,400	14,699	4,089	8,488	14,724	22,425	25,144	10,431
1033	Burg2_St_1 pool	Burg2	Reference	3	2,5	1	11,847	28,408	59,745	7,024	114,800	11,847	2,909	8,522	16,977	21,403	27,042	11,300
1034	Burg2_St_2 pool	Burg2	Reference	3	7,5	2	11,847	28,408	59,745	7,062	96,700	11,847	2,909	8,522	16,977	21,403	27,042	11,300
1035	Burg2_St_3 pool	Burg2	Reference	3	27,5	3	11,847	28,408	59,745	6,997	79,900	11,847	2,909	8,522	16,977	21,403	27,042	11,300
1036	Burg2_Ref_1 pool	Burg2	Standard	1	2,5	1	11,325	23,661	65,014	6,924	58,000	11,325	3,877	0,561	19,223	17,594	31,495	15,925
1037	Burg2_Ref_2 pool	Burg2	Standard	1	7,5	2	11,325	23,661	65,014	6,967	55,300	11,325	3,877	0,561	19,223	17,594	31,495	15,925
1038	Burg2_Ref_3 pool	Burg2	Standard	1	27,5	3	11,325	23,661	65,014	6,638	50,400	11,325	3,877	0,561	19,223	17,594	31,495	15,925
1039	Eis_P_1 pool	Eisgam	Pioneer	2	2,5	1	14,981	28,238	56,781	7,346	121,300	14,981	1,520	14,058	12,660	11,684	19,130	25,967
1040	Eis_P_2 pool	Eisgam	Pioneer	2	7,5	2	14,981	28,238	56,781	7,197	106,300	14,981	1,520	14,058	12,660	11,684	19,130	25,967
1041	Eis_P_3 pool	Eisgam	Pioneer	2	27,5	3	14,981	28,238	56,781	6,422	67,900	14,981	1,520	14,058	12,660	11,684	19,130	25,967
1042	Eis_St_1 pool	Eisgam	Reference	3	2,5	1	15,152	31,378	53,470	6,697	61,100	15,152	6,156	12,575	12,647	10,776	16,006	26,688
1043	Eis_St_2 pool	Eisgam	Reference	3	7,5	2	15,152	31,378	53,470	6,436	54,300	15,152	6,156	12,575	12,647	10,776	16,006	26,688
1044	Eis_St_3 pool	Eisgam	Reference	3	27,5	3	15,152	31,378	53,470	6,205	43,300	15,152	6,156	12,575	12,647	10,776	16,006	26,688
1045	Eis_Ref_1 pool	Eisgam	Standard	1	2,5	1	16,371	33,981	49,648	6,478	48,600	16,371	8,591	11,995	13,396	11,012	15,024	23,612
1046	Eis_Ref_2 pool	Eisgam	Standard	1	7,5	2	16,371	33,981	49,648	6,519	58,100	16,371	8,591	11,995	13,396	11,012	15,024	23,612
1047	Eis_Ref_3 pool	Eisgam	Standard	1	27,5	3	16,371	33,981	49,648	6,352	54,600	16,371	8,591	11,995	13,396	11,012	15,024	23,612
1048	Fischa_P_1 pool	Fischame	Pioneer	2	2,5	1	22,593	57,865	19,542	7,843	178,700	22,593	7,719	15,027	35,118	13,043	5,981	0,518
1049	Fischa_P_2 pool	Fischame	Pioneer	2	7,5	2	22,593	57,865	19,542	7,992	169,000	22,593	7,719	15,027	35,118	13,043	5,981	0,518
1050	Fischa_P_3 pool	Fischame	Pioneer	2	27,5	3	22,593	57,865	19,542	7,941	152,600	22,593	7,719	15,027	35,118	13,043	5,981	0,518
1051	Fischa_St_1 pool	Fischame	Reference	3	2,5	1	21,601	59,520	18,878	7,978	173,800	21,601	7,079	17,156	35,285	12,526	4,652	1,700
1052	Fischa_St_2 pool	Fischame	Reference	3	7,5	2	21,601	59,520	18,878	7,992	144,000	21,601	7,079	17,156	35,285	12,526	4,652	1,700
1053	Fischa_St_3 pool	Fischame	Reference	3	27,5	3	21,601	59,520	18,878	7,946	128,000	21,601	7,079	17,156	35,285	12,526	4,652	1,700
1054	Fischa_Ref_1 pool	Fischame	Standard	1	2,5	1	26,670	60,341	12,989	7,944	123,000	26,670	10,085	14,180	36,076	9,627	2,834	0,528
1055	Fischa_Ref_2 pool	Fischame	Standard	1	7,5	2	26,670	60,341	12,989	7,950	121,700	26,670	10,085	14,180	36,076	9,627	2,834	0,528
1056	Fischa_Ref_3 pool	Fischame	Standard	1	27,5	3	26,670	60,341	12,989	8,000	124,400	26,670	10,085	14,180	36,076	9,627	2,834	0,528
1057	Grü_P_1 pool	Grübern	Pioneer	2	2,5	1	21,650	64,140	14,210	7,997	151,400	21,650	7,113	18,526	38,501	7,537	3,175	3,498
1058	Grü_P_2 pool	Grübern	Pioneer	2	7,5	2	21,650	64,140	14,210	7,924	131,500	21,650	7,113	18,526	38,501	7,537	3,175	3,498
1059	Grü_P_3 pool	Grübern	Pioneer	2	27,5													

1087	Man1_St_1 pool	Man1	Reference	3	2,5	1	17,802	26,406	55,792	7,511	149,900	17,802	7,226	6,283	12,897	21,878	22,622	11,293
1088	Man1_St_2 pool	Man1	Reference	3	7,5	2	17,802	26,406	55,792	7,439	122,900	17,802	7,226	6,283	12,897	21,878	22,622	11,293
1089	Man1_St_3 pool	Man1	Reference	3	27,5	3	17,802	26,406	55,792	7,374	95,900	17,802	7,226	6,283	12,897	21,878	22,622	11,293
1090	Man1_Ref_1 pool	Man1	Standard	1	2,5	1	19,681	29,238	51,081	7,288	56,600	19,681	4,612	10,250	14,375	20,561	20,694	9,826
1091	Man1_Ref_2 pool	Man1	Standard	1	7,5	2	19,681	29,238	51,081	7,244	53,400	19,681	4,612	10,250	14,375	20,561	20,694	9,826
1092	Man1_Ref_3 pool	Man1	Standard	1	27,5	3	19,681	29,238	51,081	7,202	69,900	19,681	4,612	10,250	14,375	20,561	20,694	9,826
1093	Man2_P_1 pool	Man2	Pioneer	2	2,5	1	30,516	58,931	10,553	7,553	220,000	30,516	16,994	27,252	14,685	7,199	2,704	0,650
1094	Man2_P_2 pool	Man2	Pioneer	2	7,5	2	30,516	58,931	10,553	7,431	189,400	30,516	16,994	27,252	14,685	7,199	2,704	0,650
1095	Man2_P_3 pool	Man2	Pioneer	2	27,5	3	30,516	58,931	10,553	7,524	174,200	30,516	16,994	27,252	14,685	7,199	2,704	0,650
1096	Man2_St_1 pool	Man2	Reference	3	2,5	1	29,886	44,462	25,652	7,655	222,000	29,886	14,058	17,378	13,026	16,451	6,071	3,130
1097	Man2_St_2 pool	Man2	Reference	3	7,5	2	29,886	44,462	25,652	7,621	157,700	29,886	14,058	17,378	13,026	16,451	6,071	3,130
1098	Man2_St_3 pool	Man2	Reference	3	27,5	3	29,886	44,462	25,652	7,605	153,800	29,886	14,058	17,378	13,026	16,451	6,071	3,130
1099	Man2_Ref_1 pool	Man2	Standard	1	2,5	1	36,821	56,642	6,537	7,576	171,700	36,821	18,648	29,530	8,465	3,993	2,001	0,543
1100	Man2_Ref_2 pool	Man2	Standard	1	7,5	2	36,821	56,642	6,537	7,548	159,500	36,821	18,648	29,530	8,465	3,993	2,001	0,543
1101	Man2_Ref_3 pool	Man2	Standard	1	27,5	3	36,821	56,642	6,537	7,505	151,300	36,821	18,648	29,530	8,465	3,993	2,001	0,543
1102	Moos1_P_1 pool	Moosbrun	Pioneer	2	2,5	1	36,756	43,718	19,526	7,628	190,000	36,756	10,618	19,564	13,536	12,265	3,871	3,391
1103	Moos1_P_2 pool	Moosbrun	Pioneer	2	7,5	2	36,756	43,718	19,526	7,807	165,500	36,756	10,618	19,564	13,536	12,265	3,871	3,391
1104	Moos1_P_3 pool	Moosbrun	Pioneer	2	27,5	3	36,756	43,718	19,526	7,865	151,600	36,756	10,618	19,564	13,536	12,265	3,871	3,391
1105	Moos1_St_1 pool	Moosbrun	Reference	3	2,5	1	33,595	42,029	24,376	7,636	240,000	33,595	9,043	17,372	15,613	11,900	6,368	6,108
1106	Moos1_St_2 pool	Moosbrun	Reference	3	7,5	2	33,595	42,029	24,376	7,288	206,000	33,595	9,043	17,372	15,613	11,900	6,368	6,108
1107	Moos1_St_3 pool	Moosbrun	Reference	3	27,5	3	33,595	42,029	24,376	7,514	178,000	33,595	9,043	17,372	15,613	11,900	6,368	6,108
1108	Moos1_Ref_1 pool	Moosbrun	Standard	1	2,5	1	34,110	49,184	16,706	7,545	190,000	34,110	10,582	16,921	21,681	11,924	2,760	2,022
1109	Moos1_Ref_2 pool	Moosbrun	Standard	1	7,5	2	34,110	49,184	16,706	7,504	179,700	34,110	10,582	16,921	21,681	11,924	2,760	2,022
1110	Moos1_Ref_3 pool	Moosbrun	Standard	1	27,5	3	34,110	49,184	16,706	7,613	165,000	34,110	10,582	16,921	21,681	11,924	2,760	2,022
1111	Ro1_P_1 pool	Rod1	Pioneer	2	2,5	1	12,960	45,377	41,664	6,561	120,500	12,960	5,990	11,876	27,511	9,973	19,942	11,749
1112	Ro1_P_2 pool	Rod1	Pioneer	2	7,5	2	12,960	45,377	41,664	6,571	119,400	12,960	5,990	11,876	27,511	9,973	19,942	11,749
1113	Ro1_P_3 pool	Rod1	Pioneer	2	27,5	3	12,960	45,377	41,664	6,574	112,000	12,960	5,990	11,876	27,511	9,973	19,942	11,749
1114	Ro1_St_1 pool	Rod1	Reference	3	2,5	1	15,322	43,944	40,735	6,518	133,200	15,322	6,536	14,589	22,818	14,607	12,674	13,454
1115	Ro1_St_2 pool	Rod1	Reference	3	7,5	2	15,322	43,944	40,735	6,542	74,700	15,322	6,536	14,589	22,818	14,607	12,674	13,454
1116	Ro1_St_3 pool	Rod1	Reference	3	27,5	3	15,322	43,944	40,735	6,478	60,900	15,322	6,536	14,589	22,818	14,607	12,674	13,454
1117	Ro1_Ref_1 pool	Rod1	Standard	1	2,5	1	11,495	42,868	45,637	6,466	84,400	11,495	5,798	11,649	25,420	14,175	14,387	17,075
1118	Ro1_Ref_2 pool	Rod1	Standard	1	7,5	2	11,495	42,868	45,637	5,933	103,400	11,495	5,798	11,649	25,420	14,175	14,387	17,075
1119	Ro1_Ref_3 pool	Rod1	Standard	1	27,5	3	11,495	42,868	45,637	5,877	82,700	11,495	5,798	11,649	25,420	14,175	14,387	17,075
1120	Ro2_P_1 pool	Rod2	Pioneer	2	2,5	1	26,064	57,352	16,585	6,750	83,100	26,064	7,798	18,317	31,237	6,345	4,635	5,605
1121	Ro2_P_2 pool	Rod2	Pioneer	2	7,5	2	26,064	57,352	16,585	6,842	75,400	26,064	7,798	18,317	31,237	6,345	4,635	5,605
1122	Ro2_P_3 pool	Rod2	Pioneer	2	27,5	3	26,064	57,352	16,585	6,875	69,000	26,064	7,798	18,317	31,237	6,345	4,635	5,605
1123	Ro2_St_1 pool	Rod2	Reference	3	2,5	1	22,894	57,972	19,135	6,962	145,200	22,894	6,511	21,601	29,860	6,948	7,008	5,178
1124	Ro2_St_2 pool	Rod2	Reference	3	7,5	2	22,894	57,972	19,135	7,046	113,200	22,894	6,511	21,601	29,860	6,948	7,008	5,178
1125	Ro2_St_3 pool	Rod2	Reference	3	27,5	3	22,894	57,972	19,135	6,896	87,000	22,894	6,511	21,601	29,860	6,948	7,008	5,178
1126	Ro2_Ref_1 pool	Rod2	Standard	1	2,5	1	30,718	54,457	14,825	6,665	61,300	30,718	8,307	16,461	29,688	5,560	3,834	5,431
1127	Ro2_Ref_2 pool	Rod2	Standard	1	7,5	2	30,718	54,457	14,825	6,445	54,000	30,718	8,307	16,461	29,688	5,560	3,834	5,431
1128	Ro2_Ref_3 pool	Rod2	Standard	1	27,5	3	30,718	54,457	14,825	6,461	46,500	30,718	8,307	16,461	29,688	5,560	3,834	5,431
1129	Sb_P_1 pool	Schach1	Pioneer	2	2,5	1	27,071	46,869	26,060	7,393	62,900	27,071	9,040	16,752	21,077	16,032	6,646	3,383
1130	Sb_P_2 pool	Schach1	Pioneer	2	7,5	2	27,071	46,869	26,060	7,190	62,700	27,071	9,040	16,752	21,077	16,032	6,646	3,383
1131	Sb_P_3 pool	Schach1	Pioneer	2	27,5	3	27,071	46,869	26,060	7,025	44,600	27,071	9,040	16,752	21,077	16,032	6,646	3,383
1132	Sb_St_1 pool	Schach1	Reference	3	2,5	1	28,726	45,011	26,263	7,645	149,600	28,726	8,685	17,779	18,548	15,711	7,199	3,354
1133	Sb_St_2 pool	Schach1	Reference	3	7,5	2	28,726	45,011	26,263	7,954	158,300	28,726	8,685	17,779	18,548	15,711	7,199	3,354
1134	Sb_St_3 pool	Schach1	Reference	3	27,5	3	28,726	45,011	26,263	7,954	152,400	28,726	8,685	17,779	18,548	15,711	7,199	3,354
1135	Sb_Ref_1 pool	Schach1	Standard	1	2,5	1	30,404	43,099	26,497	7,372	115,700	30,404	9,472	14,819	18,808	15,749	7,103	3,645
1136	Sb_Ref_2 pool	Schach1	Standard	1	7,5	2	30,404	43,099	26,497	7,479	100,500	30,404	9,472	14,819	18,808	15,749	7,103	3,645
1137	Sb_Ref_3 pool	Schach1	Standard	1	27,5	3	30,404	43,099	26,497	7,546	90,200	30,404	9,472	14,819	18,808	15,749	7,103	3,645
1138	Schach1_P_1 pool	Schach2	Pioneer	2	2,5	1	47,660	37,752	14,588	7,837	154,800	47,660	11,401	15,095	11,257	8,792	2,604	3,192
1139	Schach1_P_2 pool	Schach2	Pioneer	2	7,5	2	47,660	37,752	14,588	7,849	151,100	47,660	11,401	15,095	11,257	8,792	2,604	3,192
1140	Schach1_P_3 pool	Schach2	Pioneer	2	27,5	3	47,660	37,752	14,588	7,887	134,000	47,660	11,401	15,095	11,257	8,792	2,604	3,192
1141	Schach1_St_1 pool	Schach2	Reference	3	2,5	1	47,818	34,804	17,379	7,841	239,000	47,818	12,876	15,462	6,465	10,243	3,980	3,155
1142	Schach1_St_2 pool	Schach2	Reference	3	7,5	2	47,818	34,804	17,379	7,818	186,100	47,818	12,876	15,462	6,465	10,243	3,980	3,155
1143	Schach1_St_3 pool	Schach2	Reference	3	27,5	3	47,818	34,804	17,379	7,880	155,500	47,818	12,876	15,462	6,465	10,243	3,980	3,155
1144	Schach1_Ref_1 pool	Schach2	Standard	1	2,5	1	46,255	41,452	12,293	7,816	211,000	46,255	13,849	13,586	14,017	7,832	2,439	2,022
1145	Schach1_Ref_2 pool	Schach2	Standard	1	7,5	2	46,255	41,452	12,293	7,943	147,900	46,255	13,849	13,586	14,017	7,832	2,439	2,022
1146	Schach1_Ref_3 pool	Schach2	Standard	1	27,5	3	46,255	41,452	12,293	7,904	150,100	46,255	13,849	13,586	14,017	7,832	2,439	2,022
1147	Schach2_P_1 pool	Steinabr	Pioneer	2	2,5	1	18,736	72,352	8,912	7,894	145,200	18,736	8,931	20,274	43,147	7,166	1,247	0,499
1148	Schach2_P_2 pool	Steinabr	Pioneer	2	7,5	2	18,736	72,352	8,912	7,928	127,600	18,736	8,931	20,274	43,147	7,166	1,247	0,499
1149	Schach2_P_3 pool	Steinabr	Pioneer	2	27,5	3	18,736	72,352	8,912	7,850	117,200	18,736	8,931	20,274	43,147	7,166	1,247	0,499
1150	Schach2_St_1 pool	Steinabr	Reference	3	2,5	1	20,678	71,174	8,148	7,926	192,600	20,678	8,197	23,321	39,656	5,545	1,564	1,040
1151	Schach2_St_2 pool	Steinabr	Reference	3	7,5	2	20,678	71,174	8,148	7,873	152,600	20,678	8,197	23,321	39,656	5,545	1,564	1,040
1152	Schach2_St_3 pool	Steinabr	Reference	3	27,5	3	20,678	71,174	8,148	7,861	142,500	20,678	8,197	23				

Lab_ID	Sample_ID	Site	System_ID	Corg	DOC	Cnratio	AGGSTAB	CEC	Al_Dithionit	Mn_Dithionit	Fe_Dithionit	Al_Oxalat	Mn_Oxalat	Fe_Oxalat	Fe_Di_minus_Fe_Ox	Fe_Di_div_Fe_Ox	pH	EC	WC	Ntot	Ctot	Canorg	C/N
994	Abs_P_1 pool	Absdorf	Pioneer	2,954	258,513	13,188	0,713	330,934	793,552	453,646	10844,805	1883,731	490,408	2095,763	8749,042	5,175	7,826	139,700	3,247	0,224	1,337	13,18786	
995	Abs_P_2 pool	Absdorf	Pioneer	2,424	143,438	13,773	0,816	330,934	793,552	453,646	10844,805	1883,731	490,408	2095,763	8749,042	5,175	7,785	126,800	3,733	0,176	1,298	13,77301	
996	Abs_P_3 pool	Absdorf	Pioneer	2,997	136,578	15,449	0,796	330,934	793,552	453,646	10844,805	1883,731	490,408	2095,763	8749,042	5,175	7,885	125,800	3,846	0,194	1,262	15,44961	
997	Abs_Sl_1 pool	Absdorf	Reference	4,055	406,121	12,477	0,867	319,880	807,570	440,466	10636,363	1910,069	496,793	2087,038	8549,325	5,096	7,840	113,500	3,568	0,148	1,174	27,39912	
998	Abs_Sl_2 pool	Absdorf	Reference	5,487	325,876	23,753	0,739	319,880	807,570	440,466	10636,363	1910,069	496,793	2087,038	8549,325	5,096	7,850	116,500	3,631	0,165	1,378	33,25458	
999	Abs_Sl_3 pool	Absdorf	Reference	4,888	285,614	22,735	0,649	319,880	807,570	440,466	10636,363	1910,069	496,793	2087,038	8549,325	5,096	7,870	117,200	3,302	0,105	1,192	46,55238	
1000	Abs_Ref_1 pool	Absdorf	Standard	2,352	129,465	15,891	0,695	276,731	550,790	344,964	7398,432	1343,623	361,789	1385,088	6013,344	5,341	7,860	203,000	2,144	0,325	6,087	2,726623	
1001	Abs_Ref_2 pool	Absdorf	Standard	2,134	116,431	12,935	0,716	276,731	550,790	344,964	7398,432	1343,623	361,789	1385,088	6013,344	5,341	7,915	177,400	2,353	0,231	5,487	0,9239177	
1002	Abs_Ref_3 pool	Absdorf	Standard	1,570	82,199	14,954	0,692	276,731	550,790	344,964	7398,432	1343,623	361,789	1385,088	6013,344	5,341	7,839	161,100	2,614	0,215	4,888	0,7303023	
1003	Au1_P_1 pool	Au1	Pioneer	3,564	318,310	12,684	0,648	284,653	359,186	216,185	3202,695	1101,959	259,880	1338,673	1864,021	2,392	7,773	147,700	2,091	0,281	7,266	3,702	
1004	Au1_P_2 pool	Au1	Pioneer	3,669	297,571	12,312	0,657	284,653	359,186	216,185	3202,695	1101,959	259,880	1338,673	1864,021	2,392	7,858	138,800	2,197	0,298	6,944	3,275	
1005	Au1_P_3 pool	Au1	Pioneer	2,681	238,959	12,078	0,630	284,653	359,186	216,185	3202,695	1101,959	259,880	1338,673	1864,021	2,392	7,911	131,800	2,096	0,222	6,824	3,603	
1006	Au1_Sl_1 pool	Au1	Reference	5,753	549,878	12,426	0,923	249,327	352,599	217,974	3102,884	1081,647	235,203	1134,607	1968,276	2,735	7,955	115,200	1,885	0,222	6,404	2,489	
1007	Au1_Sl_2 pool	Au1	Reference	4,827	527,922	18,507	0,860	249,327	352,599	217,974	3102,884	1081,647	235,203	1134,607	1968,276	2,735	7,948	113,100	1,935	0,166	6,461	3,378	
1008	Au1_Sl_3 pool	Au1	Reference	3,881	375,607	12,682	0,753	249,327	352,599	217,974	3102,884	1081,647	235,203	1134,607	1968,276	2,735	7,966	120,000	1,781	0,153	6,429	1,923	
1009	Au1_Ref_1 pool	Au1	Standard	3,915	190,817	17,636	0,980	199,888	237,968	179,270	3416,008	563,506	172,129	1537,096	1878,912	2,222	7,180	175,000	1,524	0,463	8,288	2,535	
1010	Au1_Ref_2 pool	Au1	Standard	3,083	152,171	18,574	0,532	199,888	237,968	179,270	3416,008	563,506	172,129	1537,096	1878,912	2,222	7,044	154,800	1,469	0,250	7,079	2,452	
1011	Au1_Ref_3 pool	Au1	Standard	4,506	128,769	29,454	0,551	199,888	237,968	179,270	3416,008	563,506	172,129	1537,096	1878,912	2,222	7,107	163,500	1,165	0,306	6,803	2,922	
1012	Au2_P_1 pool	Au2	Pioneer	2,616	302,295	12,638	0,806	113,110	339,711	214,144	4432,677	598,239	304,670	1639,540	2793,137	2,704	7,301	91,200	0,856	0,207	2,616	0,000	
1013	Au2_P_2 pool	Au2	Pioneer	2,404	260,053	12,141	0,761	113,110	339,711	214,144	4432,677	598,239	304,670	1639,540	2793,137	2,704	7,277	83,200	0,756	0,198	2,404	0,000	
1014	Au2_P_3 pool	Au2	Pioneer	2,901	266,280	14,505	0,716	113,110	339,711	214,144	4432,677	598,239	304,670	1639,540	2793,137	2,704	7,365	82,400	0,705	0,200	2,901	0,000	
1015	Au2_Sl_1 pool	Au2	Reference	4,250	325,315	12,213	0,949	57,065	452,873	226,576	5140,637	621,553	292,956	1608,862	3531,775	3,195	6,808	44,800	0,604	0,037	0,829	0,000	
1016	Au2_Sl_2 pool	Au2	Reference	3,472	283,037	11,730	0,917	57,065	452,873	226,576	5140,637	621,553	292,956	1608,862	3531,775	3,195	6,712	35,100	0,552	0,095	1,267	0,000	
1017	Au2_Sl_3 pool	Au2	Reference	3,598	254,094	12,450	0,884	57,065	452,873	226,576	5140,637	621,553	292,956	1608,862	3531,775	3,195	6,606	36,100	0,704	0,105	1,360	0,000	
1018	Au2_Ref_1 pool	Au2	Standard	0,829	295,672	22,405	0,463	160,445	453,746	338,380	6025,104	1022,445	465,970	2317,619	3707,484	2,600	6,976	119,500	1,266	0,348	4,250	0,000	
1019	Au2_Ref_2 pool	Au2	Standard	1,267	130,431	13,198	0,338	160,445	453,746	338,380	6025,104	1022,445	465,970	2317,619	3707,484	2,600	7,075	105,500	0,756	0,296	3,472	0,000	
1020	Au2_Ref_3 pool	Au2	Standard	1,360	127,396	12,952	0,322	160,445	453,746	338,380	6025,104	1022,445	465,970	2317,619	3707,484	2,600	7,284	82,100	1,162	0,289	3,598	0,000	
1021	Burg1_P_1 pool	Burg1	Pioneer	2,622	232,632	13,516	0,523	142,595	623,472	362,402	10002,713	955,594	464,267	2709,380	7293,333	3,692	6,925	103,600	1,471	0,194	2,622	0,000	
1022	Burg1_P_2 pool	Burg1	Pioneer	1,687	218,913	14,419	0,502	142,595	623,472	362,402	10002,713	955,594	464,267	2709,380	7293,333	3,692	7,392	96,000	1,422	0,117	1,687	0,000	
1023	Burg1_P_3 pool	Burg1	Pioneer	0,996	157,122	16,328	0,468	142,595	623,472	362,402	10002,713	955,594	464,267	2709,380	7293,333	3,692	7,220	70,000	1,471	0,061	0,996	0,000	
1024	Burg1_Sl_1 pool	Burg1	Reference	5,920	547,722	13,244	0,964	170,400	646,315	430,165	10483,721	1042,451	446,624	2205,238	8278,482	4,754	7,137	70,000	1,988	0,146	2,021	0,000	
1025	Burg1_Sl_2 pool	Burg1	Reference	1,224	468,474	24,000	0,942	170,400	646,315	430,165	10483,721	1042,451	446,624	2205,238	8278,482	4,754	6,851	64,100	1,728	0,150	2,188	0,000	
1026	Burg1_Sl_3 pool	Burg1	Reference	3,804	392,032	15,590	0,813	170,400	646,315	430,165	10483,721	1042,451	446,624	2205,238	8278,482	4,754	7,210	61,300	1,886	0,113	1,955	0,000	
1027	Burg1_Ref_1 pool	Burg1	Standard	2,021	178,591	13,843	0,386	72,857	608,861	261,781	6175,340	929,995	284,030	2837,947	3337,394	2,176	6,108	62,000	1,731	0,447	5,920	0,000	
1028	Burg1_Ref_2 pool	Burg1	Standard	2,188	171,007	14,587	0,384	72,857	608,861	261,781	6175,340	929,995	284,030	2837,947	3337,394	2,176	5,910	43,400	1,523	0,051	1,224	0,000	
1029	Burg1_Ref_3 pool	Burg1	Standard	1,955	171,007	17,301	0,409	72,857	608,861	261,781	6175,340	929,995	284,030	2837,947	3337,394	2,176	5,979	35,800	1,214	0,244	3,804	0,000	
1030	Burg2_P_1 pool	Burg2	Pioneer	2,765	190,714	12,511	0,623	109,580	329,341	264,596	5026,814	598,604	329,110	2789,121	2237,693	1,802	6,863	101,400	1,027	0,221	2,765	0,000	
1031	Burg2_P_2 pool	Burg2	Pioneer	1,718	185,047	12,726	0,491	109,580	329,341	264,596	5026,814	598,604	329,110	2789,121	2237,693	1,802	7,277	101,400	1,017	0,135	1,718	0,000	
1032	Burg2_P_3 pool	Burg2	Pioneer	1,437	139,532	17,313	0,311	109,580	329,341	264,596	5026,814	598,604	329,110	2789,121	2237,693	1,802	7,201	73,400	0,918	0,083	1,437	0,000	
1033	Burg2_Sl_1 pool	Burg2	Reference	2,756	284,097	14,505	0,838	69,015	384,025	504,616	4862,489	575,196	290,710	2391,692	2470,797	2,033	6,924	58,000	0,609	0,071	1,361	0,000	
1034	Burg2_Sl_2 pool	Burg2	Reference	2,205	223,764	13,696	0,640	69,015	384,025	504,616	4862,489	575,196	290,710	2391,692	2470,797	2,033	6,967	55,300	0,609	0,078	1,429	0,000	
1035	Burg2_Sl_3 pool	Burg2	Reference	1,617	170,235	17,967	0,435	69,015	384,025	504,616	4862,489	575,196	290,710	2391,692	2470,797	2,033	6,638	50,400	0,963	0,020	0,662	0,000	
1036	Burg2_Ref_1 pool	Burg2	Standard	1,361	155,718	19,169	0,420	129,529	303,012	237,435	4200,735	563,849	325,570	2046,737	2153,998	2,052	7,024	114,800	1,291	0,190	2,756	0,000	
1037	Burg2_Ref_2 pool	Burg2	Standard	1,429	165,399	18,321	0,395	129,529	303,012	237,435	4200,735	563,849	325,570	2046,737	2153,998	2,052	7,082	96,700	1,228	0,161	2,205	0,000	
1038	Burg2_Ref_3 pool	Burg2	Standard	0,662	161,439	33,100	0,355	129,529	303,012	237,435	4200,735	563,849	325,570	2046,737	2153,998	2,052	6,997	79,900	0,916	0,090	1,617	0,000	
1039	Eis_P_1 pool	Eisgarn	Pioneer	4,853	417,939	12,907	0,772	76,521	1803,181	437,362	7506,884	3802,096	546,156	5385,954	2120,930	1,394	7,346	121,300	1,700	0,376	4,853	0,000	
1040	Eis_P_2 pool	Eisgarn	Pioneer	5,783	472,246	15,099	0,944	76,521	1803,181	437,362	7506,884	3802,096	546,156	5385,954	2120,930	1,394	7,197	106,300	2,330	0,383	5,783	0,000	
1041	Eis_P_3 pool	Eisgarn	Pioneer	3,113	346,898	14,684	0,856	76,521	1803,181	437,362	7506,884	3802,096	546,156	5385,954	2120,930	1,394	6,422	87,900	1,639	0,212	3,113	0,000	
1042	Eis_Sl_1 pool	Eisgarn	Reference																				

1057	Grü_P_1 pool	Pioneer	1,863	259,909	13,596	0,416	154,182	581,451	293,853	7130,732	1028,328	294,989	1501,152	5629,580	4,750	7,987	131,500	0,972	0,137	3,371	1,508	13,59569
1058	Grü_P_2 pool	Pioneer	1,363	200,349	13,365	0,315	154,182	581,451	293,853	7130,732	1028,328	294,989	1501,152	5629,580	4,750	7,924	131,500	1,075	0,102	2,943	1,580	13,36561
1059	Grü_P_3 pool	Pioneer	0,790	116,983	21,346	0,172	154,182	581,451	293,853	7130,732	1028,328	294,989	1501,152	5629,580	4,750	7,918	112,000	1,126	0,037	2,496	1,708	21,34568
1060	Grü_SL_1 pool	Reference	3,594	437,659	12,961	0,723	146,196	555,979	264,590	6679,319	897,340	235,567	1312,867	5366,451	5,088	7,867	130,400	1,226	0,116	3,326	2,180	30,72724
1061	Grü_SL_2 pool	Reference	1,783	225,569	15,371	0,396	146,196	555,979	264,590	6679,319	897,340	235,567	1312,867	5366,451	5,088	8,008	124,000	1,279	0,061	3,305	2,237	29,20276
1062	Grü_SL_3 pool	Reference	1,395	210,398	15,330	0,351	146,196	555,979	264,590	6679,319	897,340	235,567	1312,867	5366,451	5,088	8,052	114,600	1,021	0,049	3,274	2,427	28,46938
1063	Grü_Ref_1 pool	Standard	1,146	172,507	9,877	0,302	181,400	646,825	302,312	8542,402	993,490	263,387	1379,463	7162,938	6,193	8,052	192,600	1,869	0,275	4,797	1,233	4,166327
1064	Grü_Ref_2 pool	Standard	1,068	169,974	17,296	0,213	181,400	646,825	302,312	8542,402	993,490	263,387	1379,463	7162,938	6,193	8,002	138,000	1,385	0,116	3,269	1,486	9,2312967
1065	Grü_Ref_3 pool	Standard	0,847	143,097	17,296	0,152	181,400	646,825	302,312	8542,402	993,490	263,387	1379,463	7162,938	6,193	8,002	120,000	1,289	0,091	2,887	1,502	9,2312967
1066	Lack1_P_1 pool	Pioneer	1,820	314,426	20,222	0,860	61,342	461,471	431,393	3492,472	770,890	576,382	1676,939	1815,533	2,083	7,527	107,600	0,408	0,090	1,820	0,000	20,22222
1067	Lack1_P_2 pool	Lack1	1,390	256,712	19,857	0,751	61,342	461,471	431,393	3492,472	770,890	576,382	1676,939	1815,533	2,083	7,308	67,700	0,101	0,070	1,390	0,000	19,85714
1068	Lack1_P_3 pool	Lack1	1,120	308,621	18,667	0,492	61,342	461,471	431,393	3492,472	770,890	576,382	1676,939	1815,533	2,083	7,141	52,500	0,507	0,060	1,120	0,000	18,66667
1069	Lack1_SL_1 pool	Reference	5,220	447,667	12,429	0,894	16,095	538,139	413,394	3381,392	662,201	510,108	1475,794	1905,598	2,291	6,267	32,300	0,458	0,070	1,120	0,000	74,57143
1070	Lack1_SL_2 pool	Reference	4,650	370,094	13,677	0,625	16,095	538,139	413,394	3381,392	662,201	510,108	1475,794	1905,598	2,291	6,143	36,500	0,814	0,060	1,140	0,000	77,15
1071	Lack1_SL_3 pool	Reference	3,620	296,202	13,407	0,600	16,095	538,139	413,394	3381,392	662,201	510,108	1475,794	1905,598	2,291	5,986	34,800	0,355	0,040	1,030	0,000	90,5
1072	Lack1_Ref_1 pool	Standard	1,120	224,065	16,000	0,609	140,309	450,677	445,561	4611,521	861,117	603,133	2631,509	1980,012	1,752	7,369	203,000	1,337	0,420	5,220	0,000	2,666667
1073	Lack1_Ref_2 pool	Standard	1,140	230,392	19,000	0,598	140,309	450,677	445,561	4611,521	861,117	603,133	2631,509	1980,012	1,752	7,521	145,600	1,125	0,340	4,650	0,000	3,352941
1074	Lack1_Ref_3 pool	Standard	1,030	173,054	25,750	0,502	140,309	450,677	445,561	4611,521	861,117	603,133	2631,509	1980,012	1,752	7,237	129,900	1,027	0,270	3,620	0,000	3,614815
1075	Lack2_P_1 pool	Pioneer	2,394	237,989	11,399	0,706	165,908	269,737	400,413	3506,446	572,997	696,090	2879,536	626,910	1,218	7,902	163,600	1,556	0,210	2,590	0,196	11,39924
1076	Lack2_P_2 pool	Lack2	2,086	207,457	13,907	0,620	165,908	269,737	400,413	3506,446	572,997	696,090	2879,536	626,910	1,218	7,936	154,400	1,546	0,150	2,260	0,174	13,907
1077	Lack2_P_3 pool	Lack2	0,849	143,851	16,237	0,546	165,908	269,737	400,413	3506,446	572,997	696,090	2879,536	626,910	1,218	7,926	125,800	1,224	0,040	0,850	0,201	16,2365
1078	Lack2_SL_1 pool	Lack2	3,662	431,328	10,772	0,903	186,800	502,490	587,970	6149,682	815,353	704,352	3101,501	3048,162	1,983	7,797	125,500	1,704	0,180	2,030	0,165	20,34711
1079	Lack2_SL_2 pool	Reference	3,120	303,695	10,759	0,867	186,800	502,490	587,970	6149,682	815,353	704,352	3101,501	3048,162	1,983	7,750	124,300	1,904	0,140	1,650	0,193	22,28571
1080	Lack2_SL_3 pool	Reference	1,550	127,611	25,833	0,546	186,800	502,490	587,970	6149,682	815,353	704,352	3101,501	3048,162	1,983	7,812	113,800	1,228	0,040	0,900	0,113	38,75
1081	Lack2_Ref_1 pool	Standard	1,865	193,785	10,359	0,668	228,682	403,700	504,316	4951,548	719,221	645,195	2718,782	2232,766	1,821	7,403	129,800	2,061	0,340	3,950	0,288	5,484362
1082	Lack2_Ref_2 pool	Lack2	1,457	178,308	10,408	0,674	228,682	403,700	504,316	4951,548	719,221	645,195	2718,782	2232,766	1,821	7,669	125,100	1,862	0,290	3,120	0,000	5,024346
1083	Lack2_Ref_3 pool	Standard	0,787	102,391	19,664	0,558	228,682	403,700	504,316	4951,548	719,221	645,195	2718,782	2232,766	1,821	7,744	119,500	1,539	0,060	1,550	0,000	13,10995
1084	Man1_P_1 pool	Pioneer	2,280	236,417	12,722	0,563	145,577	621,145	408,150	7937,456	748,105	527,642	1861,060	6076,396	4,265	7,341	96,500	1,028	0,180	2,290	0,000	10,72222
1085	Man1_P_2 pool	Pioneer	2,190	170,643	12,882	0,497	145,577	621,145	408,150	7937,456	748,105	527,642	1861,060	6076,396	4,265	7,286	83,800	1,028	0,170	2,190	0,000	12,88235
1086	Man1_P_3 pool	Man1	1,622	134,530	11,584	0,351	145,577	621,145	408,150	7937,456	748,105	527,642	1861,060	6076,396	4,265	7,435	87,600	0,976	0,140	1,870	0,248	11,58396
1087	Man1_SL_1 pool	Reference	3,480	371,840	15,818	0,914	131,709	600,584	449,101	7869,638	858,032	607,016	2165,363	5704,276	3,634	7,288	56,600	0,818	0,150	2,010	0,450	23,2
1088	Man1_SL_2 pool	Reference	2,450	317,610	15,313	0,825	131,709	600,584	449,101	7869,638	858,032	607,016	2165,363	5704,276	3,634	7,244	53,400	0,922	0,130	1,730	0,247	18,84615
1089	Man1_SL_3 pool	Reference	1,930	213,280	12,063	0,621	131,709	600,584	449,101	7869,638	858,032	607,016	2165,363	5704,276	3,634	7,244	53,400	0,922	0,130	1,730	0,247	18,84615
1090	Man1_Ref_1 pool	Standard	1,580	157,259	10,403	0,468	153,115	606,657	448,559	7568,815	764,268	566,465	1864,985	5723,830	4,069	7,511	122,900	0,975	0,100	1,570	0,355	19,3
1091	Man1_Ref_2 pool	Standard	1,483	144,476	11,408	0,369	153,115	606,657	448,559	7568,815	764,268	566,465	1864,985	5723,830	4,069	7,548	159,500	2,228	0,250	3,480	0,000	7,0930048
1092	Man1_Ref_3 pool	Standard	1,483	144,476	11,408	0,369	153,115	606,657	448,559	7568,815	764,268	566,465	1864,985	5723,830	4,069	7,548	159,500	2,228	0,250	3,480	0,000	7,0930048
1093	Man2_P_1 pool	Man2	3,105	120,890	12,353	0,375	300,055	882,110	448,230	11030,217	1862,751	493,672	3140,384	7889,833	3,512	7,553	220,000	1,864	0,300	4,740	1,634	10,35283
1094	Man2_P_2 pool	Pioneer	2,820	194,539	11,749	0,356	300,055	882,110	448,230	11030,217	1862,751	493,672	3140,384	7889,833	3,512	7,431	189,400	1,909	0,240	4,580	1,760	11,74925
1095	Man2_P_3 pool	Pioneer	2,732	186,042	10,507	0,597	300,055	882,110	448,230	11030,217	1862,751	493,672	3140,384	7889,833	3,512	7,574	174,200	2,071	0,260	4,440	1,708	10,507
1096	Man2_SL_1 pool	Reference	7,481	201,198	11,875	0,729	296,665	447,634	391,105	9260,505	2122,840	404,961	3759,993	5600,512	2,463	7,576	171,700	2,395	0,270	4,390	1,195	27,70707
1097	Man2_SL_2 pool	Reference	4,703	201,198	12,060	0,938	312,357	861,500	391,105	9260,505	2122,840	404,961	3759,993	5600,512	2,463	7,548	159,500	2,228	0,250	3,420	1,095	18,15336
1098	Man2_SL_3 pool	Reference	4,656	340,774	12,263	0,715	312,357	861,500	391,105	9260,505	2122,840	404,961	3759,993	5600,512	2,463	7,505	151,300	2,127	0,240	4,190	1,276	19,40005
1099	Man2_Ref_1 pool	Standard	3,195	201,058	11,834	0,534	359,563	714,005	264,444	5887,623	2282,380	268,683	1385,944	4501,679	4,248	7,621	157,700	2,183	0,390	6,490	1,519	5,0715524
1100	Man2_Ref_2 pool	Standard	3,225	188,733	12,901	0,474	359,563	714,005	264,444	5887,623	2282,380	268,683	1385,944	4501,679	4,248	7,621	157,700	2,183	0,390	6,490	1,787	8,27
1101	Man2_Ref_3 pool	Standard	2,914	180,916	12,141	0,525	359,563	714,005	264,444	5887,623	2282,380	268,683	1385,944	4501,679	4,248	7,605	153,800	2,133	0,380	6,470	1,814	7,667842
1102	Moos1_P_1 pool	Moosbrun	4,728	286,012	13,132	0,615	296,665	447,634	199,022	3256,655	1782,617	113,171	1456,123	1800,532	2,237	7,628	190,000	1,616	0,360	9,560	4,832	13,13225
1103	Moos1_P_2 pool	Moosbrun	4,074	254,400	13,143	0,729	296,665	447,634	199,022	3256,655	1782,617	113,171	1456,123	1800,532	2,237	7,807	165,500	1,468	0,310	9,000	4,926	13,14284
1104	Moos1_P_3 pool	Moosbrun	3,802	200,425	14,083	0,647	296,665	447,634	199,022	3256,655	1782,617	113,171	1456,123	1800,532	2,237	7,865	151,600	1,718	0,270	8,680		

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