

The Soil and Its Processes Must Be Noticed

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At the 65th annual ceremony of the Estonian University of Life Sciences, I had the gratifying opportunity to speak about the soil, teaching and the science around it and its connection with the society. Such an age might seem dignified for one organization, but six and a half decades is just a jiff when compared to the time it takes for soil to form.

The contemporary soil science is a relatively young scientific field. Its classical and nowadays widely accepted principles were formed in the second half of the 19th century. The history of the teaching of soil is, however, significantly older here in Estonia as well. Namely, Johann Wilhelm Krause who was the Professor of agriculture and civil architecture started to cover soil topics in his lectures on agriculture in the University of Tartu since 1806. As of 1832, soil science taught by Professor Friedrich Schmalz was an independent course in the curriculum of the university. There is no information on when the full course of soil science was included in the curricula of other universities, but it is likely that we would be among the first ones in the world on this leaderboard. This was the first in the Russian Empire back in the day. For the most part, sixty-five years ago, soil science and its teaching was transferred from the University of Tartu to the Estonian Academy of Agriculture. During that transition period, the leader of the field was Professor Osvald Hallik, whose 110th birthday was celebrated this year. The 1960s and 70s were the highlight of soil science—led by him and later by professor Loit Reintam, when academic capacity functioned in accordance with the priorities of the society and practical outputs.

Here, a good example would be the research of the liming of acidic soils that became the main field of study of Professor Hallik and its widespread practical implementation. Therefore, we have had the knowledge, skills, and technology to manage excess acidity in agricultural fields for decades. At the same time we know, that the liming of soils became almost non-existent in the circumstances of free market economy in Estonia after its re-independence in the 1990s. Did the new public order and the economy model really change the chemical and ecological processes in the soil-crop system, so that the liming of soils became unimportant all of a sudden? Certainly not, but suddenly the economic currents silenced the knowledge acquired at school and seemingly the soil was fine with it as well. You did not lime and—surprise, surprise—the soil produced crop the next

year as well! Soil is conciliatory and durable to lots of doings or un-doings. It seems that the soil ignores the saying “fool the field once, and it will fool you nine times”. Sure, it does fool you, but you do not understand it so quickly, because some changes in the soil are slow. Perhaps it would be better to say that if you fool the soil, you will understand no sooner than in nine years that you did not treat it right when you did not lime it on time for instance. It seems that the same has happened to liming the soil in Estonia — 10-20 years of being undercover and now, in recent years, old knowledge is honoured again and liming has been revived.

Then why do we tend to forget sometimes that soil must be treated well? By nature, a human being is mostly self-centered and values the benefits consumed on a daily basis first: delicious food and drink, comfy cotton clothes, fresh air, the beauty of a blossom and birds singing. Soil is not ranked on top here. Daily, we value the products and benefits consumed directly more. But, when giving it more thought, we do realize that all these benefits are largely dependent on the soil. Here, I would like to outline just a few examples of the role of the soil. Over 95% of food in the world is produced thanks to plants growing in the soil. The carbon stock in the soil is bigger than in the above-ground biomass and atmosphere combined — thus, the soil is more in the centre of attention thanks to the focus on the “heating” climate politics and research programs as compared to the past. However, it seems strange that the soil is visible and acknowledged not because of its value but because its value becomes visible through something else — be it the climate politics agreements or the Water Act and the Nitrates Directive.

The fact that the soil is not visible and it is not understood in the eyes of the society is a worldwide problem. To increase the awareness and the connection with the society, UN declared the past year of 2015 the international year of the soil. Surely, the Republic of Estonia voted for this proposal in the UN. The following is a true story—in the spring of 2015, a journalist goes to the ministry responsible for the field of environment in Estonia and asks which actions in connection with the international soil year our country initiates or supports so that they could gladly cover these topics in the media. What was the response from an official? “Estonia does not celebrate it. This is a strange thing ... soil is not a priority, go and ask the universities, may-be someone deals with it there”. Unfortunately, this not the only example of ignoring the soil. Similar incidents have happened regrettably more often.

The situation is not any better in science. Can you imagine a scientific article where, for instance, in the description of flora it would say that “there were herbaceous plants and woody flora in the study site” without specifying the species. Probably not! However, in numerous scientific articles of respectable journals the description of the soil is limited to the level of “arable soil — forest soil”. The next level would already be “mineral soil — peat soil”, or only a some indicators from the soil sample is presented such as pH. The fact that the soil is a whole and worthy of its name according classification is not seen very often in scientific articles about nature. Thus, awareness and appreciation are rare not only among officials but also among scientists.

Whom to blame in the silent voice of soil? You can always claim that awareness is low and that it should be raised starting from the pre-school education. It is easy to point at someone and ask why you do not know or value the soil. Certainly, the community of soil science must look at themselves in the mirror to ask why such a situation has emerged. What have we not done? Throughout decades, soil science has created a unique “foreign” language and forgotten that the majority of people as well as scientists do not understand it. We have forgotten to translate it to a language understandable to the society. Let’s take the high-quality Estonian large-scale soil map. The soil information of every Estonian field or forest site can be looked up online in the map server of the Land Board. The trouble is that there you see abbreviations such as “LP sl” for instance. Does this mean anything to you? In the language of the soil, it means “*pseudpodzolic soil with loam texture*”. Oh my! This is not much more informative as well. Sure, you can look for information material that explains the “soil language” and to turn it into understandable information for yourself. In today’s fast-paced information flow such a concentration time is not found and it is essential to translate the specific soil information for the consumer to understand it. In recent years, we have developed methods to translate the soil language in collaboration with the Agricultural Research Centre, and presumably on the 100th birthday of our republic, you can get information of the soil suitability scores to cultivate this or that crop for instance in the public map server, etc.

Soil science lacks simple words that speak to the society. Probably one of those words is “humus”, which is associated with the black colour of the soil and its quality and organic material. From the cultural and historical perspective, it is interesting that in several languages the word “human” originates from the stem of humus (*hum.*). in Latin, the word “*humus*” has different meanings (soil, land), and the English *human*, the French *homme*, and the Spanish *hombre* derive from it. In soil terminology, humus has been used for more than 200 years already. However, the content of its scientific interpretation has changed repeatedly in time. An increasing number of recent studies prove that stable humus compounds used in the characterization of the organic matter quality of the soil

during the last century are not in fact present in the soil. It is claimed that specific humus compounds are the result of a laboratory analysis, meaning that they form in the treatment of soil with a very strong alkali. It was already claimed in the 1930s that there are no miraculous unexplainable on a molecular level in the soil. Nevertheless, it has reached a wider audience through the writings of a US soil scientist, Johannes Lehmann, and his colleagues only recently. Scientists worldwide argue whether the use of the word humus should be stopped. Personally I think not. The word of humus as the advertising agent for the soil organic matter and the soil fertility has performed its work excellently in the society throughout decades — let it continue to do that. These nonexistent humus materials have never been defined for practical land use decisions. It has been the domain of specific basic scientific studies. It is true that humus concentration is not measured directly; it is a calculated value of the soil organic carbon concentration. It does not matter what colour the cat is—as long as it catches mice. It is the same with the soil organic matter — call it what you want but no-one doubts its importance in the synergy between the soil and the nature. From the narrow perspective of the basic science, the use of the word “humus” should perhaps be limited, yet it carries an immense value in finding a common language with the society.