Biocyclic Humus Soil –
Its Production, Properties and the Determinants of its Formation

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Definition

Biocyclic humus soil is a novel, nutrient- and carbon-stabilized form of organic substance with a highly fertilizing effect. It can be used in all growth stages of the plant without causing burns on young plants or general symptoms of overfertilization and corresponding nutrient losses due to leaching. It has been developed since 1998 in the context of long-term trials at Biocyclic Park in Kalamata (South Peloponnese, Greece) based on the production of high-quality compost of purely vegetal origin without the addition of soil or clay.

Properties of Biocyclic Humus Soil

Biocyclic humus soil has properties fundamentally different to commercial composts, soil conditioners or plant substrates. It can be used both for fertilisation and as a substrate or soil substitute. Particularly remarkable are the high concentration of nutrients (e.g. up to 3% nitrogen), a particularly low electrical conductivity, which indicates the absence of water-soluble compounds, an extremely high ion exchange capacity of 91.9 meq Na/100g and a proven fertilising effect (the phytotoxicity test shows 114%, which is almost 20% above the value of the best commercially used plant substrates). It is also noteworthy that no significant amounts of water-soluble nutrients could be detected in the draining test. Thus, biocyclic humus soil is not susceptible to leaching even under irrigation or high precipitation. The following table compares the properties of mature compost and biocyclic humus soil:

Characteristics	Ripe Compost	Biocyclic Humus Soil (min. 8 years)
Smell	Like forest soil	Almost no smell
Volume	Decreases while using it	Remains almost unchanged over years
Nitrogen content	1.2-2.0 %	More than 2.5 %
C:N ratio	12-20	8-12
Specific weight	600-700 g per litre	700-850 g per litre
Water solubility of nutrients	A considerable portion of nutrients can be washed out by irrigation water or rain	No nutrients washed out by irrigation water or rain
Sensitiveness	May be used only in small amounts when used for seedlings	No restriction, may be used in every stage of development from seed to fruiting period without mixing with other materials
Plant growth	Vigorous	Extremely vigorous with unusual but not unnatural shape
Plant health	Good health, better than without compost	Extremely healthy, almost no fungicides necessary
Stress resistance	Resistant against drought	Resistant against drought, heat and even slight frost
Yield	Good and stable yields if applied every year	Very good yields, much higher than expected, increasing year by year if culture crops are grown in pure biocyclic humus soil without other soil added

Quality compost as a production basis

As far as we understand to date, the systematic monitoring and control of the initial composting process according to the Lübke-Hildebrandt method is indispensable for the production of biocyclic humus soil. In this process it is important to keep the unavoidable nutrient losses in the first phase of thermal aerobic fermentation as low as possible and to reduce the emission of gases and leakage. By constantly monitoring the temperature, humidity and CO_2 content of the windrows, both the frequency with which the material has to be turned and the amount of water added can be determined precisely. The result is a nutrient- and crumb-stabilized fully ripe compost, which is characterized by a high water retention capacity and a well-balanced ratio of structuring carbon and protein-containing materials (C:N ratio) and which can already be used in arable farming and fruit growing. When used in horticulture, however, this compost is usually mixed with soil in order to avoid burns to the root system, especially in seedlings or young plants, since, even if it can be described as ripe, it can still contain a high proportion of water-soluble components.

Certification and Areas of Application

Both, the initial composting of the raw materials (olive pomace, grape pomace and olive leaves) and the subsequent refining process culminating in the carbon-stabilized humus phase in the form of biocyclic humus soil is documented in detail at Biocyclic Park and certified by the internationally recognized organic inspection body CERES.

Certified humus soil is labelled accordingly and can be used worldwide by organic farms in accordance with the EU Organic Regulation (VO 889/2008: ANNEX I), the American (NOP: §205.203 (c) (3) and Japanese (JAS: Not. 1605 Table 1) Organic Regulation as well as in accordance with the Biocyclic Vegan Standard internationally recognised by IFOAM since 2017, without restrictions with regard to quantity dosage and cultivation cultures. It plays a central role in Biocyclic Vegan Agriculture, a practice of organic farming that refrains from commercial animal husbandry and the use of animal inputs and completely relies on purely plant-based fertilisers and inputs.

Research Studies

Initial research work, in particular on the yield potential of biocyclic humus soil, was carried out as early as summer 2017 at the Agricultural University of Athens. The trials were carried out on sweet potatoes and industrial tomatoes and showed yield increases of more than one hundred percent compared with the usual fertilizer management with water-soluble mineral fertilizers.[1][2]

In Germany, the "Arbeitskreis Humuserde" (Humus Soil Working Group), founded in 2017 and involving scientists from various disciplines as well as compost producers, is currently working on the systematic recording of the parameters with which the attainment of the carbon-stabilized humus phase of a material can be measured.

Research proposals for an electron-scan microscopic analysis of the carbon structure suspected in humus soil as well as for leaching experiments under field conditions are in progress.

[1] Eisenbach et al. (2018): Effect of Biocyclic Humus Soil on Yield and Quality Parameters of Sweet Potato (Ipomoea batatas L.). Scientific Papers. Series A. Agronomy, Vol. LXI, No. 1, 2018. S.210-217. http://www.biocyclic-vegan.org/wp-content/uploads/2019/01/biocyclic-lydiaGGI40.pdf

[2] Eisenbach et al. (2019): Effect of Biocyclic Humus Soil on Yield and Quality Parameters of Processing Tomato (Lycopersicon esculentum Mill.). Bulletin of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca (in publishing process).

The explanatory model

The reason for the change of characteristics of biocyclic humus soil in relation to mature compost seems to be the structure of the carbon molecules which account for up to 80 % of the organic matter in biocyclic humus soil. There is strong evidence that this structure changes naturally during the refinement process from mature compost to humus soil, similar to the charring of plant parts ('terra preta', 'biochar'). While in mature compost clay-humus complexes are responsible for the retention of water, air and nutrients and thereby improve soil fertility by physical means, in humus soil the carbon itself (instead of clay) is supposed to form stable complexes consisting of amorphous grid structures which apparently are responsible for the complete retention of nutrients. The density of these grids seems to be so high, that water molecules cannot easily penetrate these structures, while smaller molecules such as acids which can be excreted by roots and microbes, are able to do so.

In other words, biocyclic humus soil is a substrate with a high fertilising effect, but without containing any water-soluble nutrients. The absence of water-soluble nutrients forces the plant —in addition to water uptake, which takes place passively through osmotic processes in the plant tissue— to activate its natural active nutrient absorption mechanisms, which are fully adapted to an environment where water-soluble nutrients are not available, as is the case in natural forests or other natural ecosystems.

In contrast to the administration of nutrients, which are dissolved in water in the form of salts, as is the case in most currently established forms of agriculture, in which plants have to absorb all substances dissolved in water in an unselected —which means virtually passive— manner (the basis of the theory of plant nutrition applied so far), the plant, whose root system develops in humus soil, can absorb nutrients actively and thus selectively, absorbing exactly the nutrients corresponding to the needs of its respective stage of development. This ensures that the plant is permanently supplied close to the optimum, which leads to unusually balanced and strong growth. Plants growing in pure biocyclic humus soil are therefore no longer dependent on water-soluble fertilizers.

Conclusion

The transition of organic carbon into a pre-crystalline grid structure appears to be a process that takes several years. Probably only the first part of this process is induced and amplified by microbial activity (rotting). There are indications that at the end of the process the formation of carbon grids is supported by other degradation factors than the biological ones known so far. These factors have recently become subject to scientific research. There is some evidence that the grid formation cannot be influenced by the same means as those which accelerate biological processes in the early stages of ripening. It is conceivable, however, that the entry into the carbon-stabilized humus phase can be facilitated by the addition of a carrier substance which triggers a molecular-specific information transfer with an impulse effect on the spontaneous agglomeration of low-molecular carbon compounds. At present we only know, that the factor time is of crucial importance. As a rule, experience to date has shown that a stabilization period of at least 4 to 8 years is required once the starting material (quality compost) has reached full maturity. In order to make sufficient quantities of biocyclic humus soil available to agriculture in the future, research should focus in particular on the question of whether, where and how the stabilisation process, which apparently starts naturally under certain circumstances, can be influenced or accelerated.