Enzymatic Activity

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crop rotation organic system conventional system soil chemical properties soil enzymatic activity

1. Inroduction

Organic agriculture has been and is a response to the intensification of agricultural production—excessive use of mineral fertilizers and pesticides as well as related environmental pollution. Agriculture intensification is thought to be a cause of soil degradation [1]. This entry presents the effect of organic and conventional agriculture on the chemical properties and enzymatic activity of loess soil. Organic matter (which is the basis for fertilization under the organic system) has an important influence on soil quality, improvement of its structure, and increased water capacity. Many studies indicate that practices used in organic agriculture generally increase soil biological and enzymatic activity through greater accumulation of organic matter. This is achieved by using catch crops, farmyard manure, and reduced tillage practices [2,3].

Soil enzymes are natural mediators and catalysts of many important soil processes, such as: decomposition of organic matter released into soil during plant growth, processes of soil humus formation and decomposition, the release of mineral nutrients and their supply to plants, fixation of molecular nitrogen, and the flow of carbon, nitrogen and other major elements of the biochemical cycle [4,5]. It is necessary to determine enzymatic activity and to understand factors regulating it in order to characterize soil metabolic potential and fertility. This can be used to study biochemical processes occurring in soil and to evaluate soil quality [6,7,8,9]. Information regarding enzymatic activity, coupled with information on other soil properties, facilitate the selection of soil use [10,11].

Enzymatic activity is a sensitive indicator of changes in soil environment, and it changes depending on the farming system. Dehydrogenase and protease activity, as well as organic carbon and total nitrogen content, are higher in the soil in which crop rotation is used than in soil where crops are grown in monoculture [4]. Gianfreda et al. [12] have similar observations. Saviozzi et al. [13] recorded higher values for soil metabolic potential and the biological index of fertility (BIF) in a meadow than in a cereal field. According to Dahm [14] and Burns [15], the effects of higher plants on soil enzymes depend on the plant chemical composition, which, even in the case of root exudates alone, can exhibit significant differences between various genera, species, and also varieties. Krämer et al. [16]

think that plants stimulate soil enzymatic activity due to increased biomass of enzyme-producing microbes. Woźniak [17] demonstrated that legumes (pea) had a more beneficial effect on soil enzymes than cereal crops.

Soil enzymatic activity is considered to be an essential parameter that reveals the status of the natural environment and shows the biochemical process that occurs in the environment. This parameter reflects the level and extent of pollution found in the environment [8]. Soil enzymatic activity can be influenced through agronomic practices (fertilization) [9]. Farming system (organic or conventional) and catch crops (in particular under the organic system) also have a significant impact on the activity of soil enzymes [18,19]. Catch crops are used to improve soil organic matter content, prevent the leaching of nutrients (predominantly nitrogen and phosphorus), and enhance the activity of soil microbes [20,21].

2. Selected soil chemical components (0–20 cm profile)

Table 1. Selected soil chemical components (0–20 cm profile)—mean for 2017–2019.

Crop plant	Farming system	pH 1M KCl	Organic C %	Total N %	C/N	P mg kg^{-1}	K mg kg^{-1}
Sugar beet	Organic	6.7 ± 0.1**	1.50 ± 0.11	0.16 ± 0.03	9.3 ± 0.1	159.8 ± 2.2	240.1 ± 2.5
	Conventional	6.4 ± 0.1	0.98 ± 0.08	0.09 ± 0.02	10.8 ± 0.2	192.5 ± 1.9	274.2 ± 3.1
Mean		6.5	1.24	0.12	10.0	176.1	257.15
Spring barley	Organic	6.5 ± 0.2	0.81 ± 0.03	0.09 ± 0.02	9.0 ± 0.2	139.6 ± 2.0	226.0 ± 1.7
	Conventional	6.1 ± 0.1	0.70 ± 0.04	0.06 ± 0.01	10.0 ± 0.2	180.7 ± 1.6	251.9 ± 1.9
Mean		6.3	0.75	0.07	9.5	160.1	238.9

Red clover	Organic	6.6 ± 0.2	1.19 ± 0.05	0.13 ± 0.04	9.1 ± 0.1	146.8 ± 2.0	219.8 ± 2.5
	Conventional	6.3 ± 0.1	0.93 ± 0.03	0.09 ± 0.03	10.3 ± 0.1	170.2 ± 1.8	243.3 ± 2.6
Mean		6.4	1.06	0.11	9.7	158.5	231.5
Winter wheat	Organic	6.4 ± 0.1	0.86 ± 0.04	0.09 ± 0.02	9.5 ± 0.3	141.0 ± 0.8	231.6 ± 1.8
	Conventional	6.0 ± 0.2	0.72 ± 0.01	0.07 ± 0.02	10.2 ± 0.2	186.7 ± 1.4	260.4 ± 2.6
Mean		6.2	0.79	0.08	9.8	163.8	246.0
Oats	Organic	6.4 ± 0.1	1.03 ± 0.05	0.10 ± 0.03	10.3 ± 0.2	150.2 ± 2.4	219.7 ± 2.2
	Conventional	6.0 ± 0.2	0.96 ± 0.04	0.09 ± 0.03	10.6 ± 0.2	178.8 ± 2.7	242.4 ± 2.4
Mean		6.2	0.99	0.09	10.4	164.5	231.0
HSD $_{(0.05)}$ for farming system (A)		0.29	0.112	0.022	0.72	44.62	33.23
HSD $_{(0.05)}$ for crop plant (B)		0.28	0.178	0.015	n.s.	19.4	24.92
HSD $_{(0.05)}$ for interaction (A × B)		n.s.*	0.214	0.029	n.s.	n.s.	n.s.

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HSD $_{(0.05)}$ for years (C)—not significant differences. HSD $_{(0.05)}$ for interaction (A × B × C)—not significant differences. * n.s.—not significant differences; ** SD—standard deviation.

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