MICROBIAL BIOMASS IN CROP-ROTATION AND PERMANENT CROP

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Abstract: At present, the study and estimation of microbial biomass and also the soil micro-organisms productivity are very interesting for the studies. The researches were initiated in summer of 2004 in long term crop-rotation of “Selection” Institute for Crop Studies The selected crop-rotation for experiments is saturated with row crops and cereal crops, meaning beet sugar and autumn wheat. The obtained results suggest the idea that the soil in our researches accumulates a great quantity of microbial biomass that favorable reflects on soil quality.

INTRODUCTION

The soil – natural body with substantial-structural, fundamental and dynamic qualities integrated in a united whole with own characteristics of biogeophysical-chemical, biogeodynamical, conditioned and climatic open system (Chirita, 1976), is subjected as a study object to anthropogenous element activity.

At present, the study and estimation of microbial biomass and also the soil micro-organisms productivity are very interesting for the studies.

In various synthesis papers there are extensive references to microbial biomass studies as one of the main components of the organic substance, and as general factor of biodiversity (1) more receptive than organic substance mass of the soil (2).

In the agricultural practice it has a special value that estimates the quantitative accumulation of nutritive elements by micro-organisms, soil fertility level.

It was ascertained that the tuning fork of microbial mass variation in various types of soil is diverse. For example, in grey forest soils and chernozems it constitutes 0.28 and 0.38 mg/C/g; grasslands – 60g/m^2, and in broad-leaved tree forests’ soils only 3.5 g/m^2.

Andersen and K. Domsch (1980) studying the microbial biomass in 29 types of arable soil, determined that at one hectare it contains 108 kg N, 83 kg P, 70 kg K,11 kg Ca, that is gradually released in accessible configuration to plants and is practically equivalent to the nutritive elements’ quantity in mineral fertilizers used in agriculture.

Other sources mention that the bacteria biomass for 1 ha can include from several hundreds to several thousands kg, and the fungus from several hundreds kg to tenths of tones, but the dry biomass of micro-organisms (bacteria, actinomycetes, fungus) determined by means of microscopic method constitutes in rich soils up to 500 kg/ha (3).

The fungus biomass prevails the bacteria biomass, and their proportion in various soils is - 75:25; 80:20; 85:15. These factors are variable and generally reflect the soil particularities.

The purpose of our investigations is the determination and distinguishing of the microbial biomass in crop-rotation and permanent crop.

MATERIALS AND METHODS

The researches were initiated in long term crop-rotation of “Selection” ICCC. The selected crop-rotation for experiments is saturated with row crops and cereal crops, meaning beet sugar and autumn wheat.

The crop-rotation 7 saturated with wheat and beet is witness, and in crop-rotation 3 the cropping is achieved by using fertilizers: for beet $N_{60}P_{30}K_{30}$ with 40 t/ha stable manure, and for wheat $N_{60}P_{30}K_{30}$ under autumn tillage, and in the spring only N_{30} kg/ha.

At the same time there are subjected to the study the same crops on fertilized and unfertilized background in permanent crop.

The researches are performed in certain vegetations periods. To determine the microbial biomass there were taken soil samples at a depth of 0-20 cm in 3 sampling periods. The laboratory analyses were performed on medium soil samples. The samples were subject to mortar processing and then they were sieved through the screen with 2 mm slots.

At the same time, to determine the soil humidity for that respective moment, a part of each sample was dehydrated in stove at 105^{o}C for 24 hours.

The total biomass and its breathing were determined with inhibitor use method (Zveaghentev, 1983).

RESULTS AND DISCUSSIONS

The investigations results presented in Table 1 and 2 show that the mineral and organic fertilizers applied in various dosages essentially influence the breathing intensity and total biomass that contributes to soil fertility level, cropped plants nutrition and productivity in crop-rotation and permanent crop.

Analyzing the data obtained in crop-rotation 3 and 7 with beet sugar it can be observed a difference between them.

The breathing in crop-rotation 3 constitutes 2.194 CO_2 mg/100g soil/hour, and the total biomass of 40.94 C mg/100g dry soil, while in crop-rotation 7 the breathing is of 1.804 CO_2 mg/100g soil/hour and the biomass of -49.71 C mg/100g dry soil. The obtained values are probably owed to organic fertilizers addition to total biomass productivity increase and soil breathing.

Comparing the crop in rotation for permanent cropping with fertilized and unfertilized background we observe a superior priority of the fertilized permanent crop over the unfertilized one. In this crop rotation the total biomass is of 75.04 C mg/100g dry soil, and in unfertilized permanent cropping is twice smaller, meaning 45.04 mg/100g dry soil. Also the micro-organism breathing is more intense in the fertilized sample, 3.32 against 1.97 CO_2 mg/100 g soil/hour for the unfertilized permanent crop.

Table 1. Microbial breathing and biomass

Variant	Crop	Breathing, CO_2 Mg/100g soil/hour	Total biomass, C Mg/100g dry soil
Crop rotating 3	Fertilized beet	2.194	49.71
Crop rotating 7	Unfertilized beet	1.804	40.94
Permanent crop	Fertilized beet	3.32	75.04
Permanent crop	Unfertilized beet	1.97	45.04
Fertilized black earth		1.68	38.11
Unfertilized black earth		1.00	22.86
Fertilized fallow land		2.80	63.34
Unfertilized fallow land		2045	55.47

Table 2 Microbial breathing and biomass

Crop rotation	Crop	Breathing, CO_2 Mg/100g soil/hour	Total biomass, C Mg/100g dry soil
Unfertilized Crop 7 (witness)	Wheat	0.50	11.61
Fertilized crop 3	Wheat	1.11	25.33
Unfertilized Crop 7 (witness)	Beet	0.50	11.61
Fertilized crop 3	Beet	0.88	20.16
Unfertilized permanent crop	Wheat	1.00	22.86
Fertilized permanent crop	Wheat	1.42	32.30
Unfertilized permanent crop	Beet	0.53	12.28
Fertilized permanent crop	Beet	0.62	14.31
Unfertilized black earth		0.91	20.83
Fertilized black earth		0.91	20.83
Unfertilized fallow land		0.50	11.61
Fertilized fallow land		0.96	21.96

The obtained and analyzed results' reviewing gives the possibility of drawing a conclusion: the microbial biomass accumulation probably depends on the quantity and quality of the nutritive substrata. The used sources to add carbon increase its quantity and its lack diminishes it. A very good example is the variant with fertilized and unfertilized black earth. In the fertilized one the total biomass and its breathing is of 38.11 and respectively 1.68, while in the unfertilized one only 22.86 C mg/100g dry soil and respectively 1.00 CO_2 mg/100g soil/hour.

In conclusion, based on the estimations made by us and linked with the information mentioned in specialty literature we can ascertain the general tendency towards increase in microbial biomass. According to data published by Zveaghintev, Golimbet 1983, the soils studied by us can be considered rich from point of view of microbial biomass accumulation. However, comparing the values of the natural biocenosis with the values of agrocenoses we observe an obvious difference between the black earth – fallow ground – crop rotation – fertilized permanent crop (38.86-63.34 – 49.71-75.04 C mg/100g dry soil) und unfertilized permanent crop (22.86 – 40.94 – 55.47 – 45,04 – C mg/100g dry soil) of the microbial biomass. Probably that as a result of various agricultural activities performed on these crops is modified also the activity rhythm of micro-organisms and this reflects upon the total biomass of the soil.

CONCLUSIONS

The obtained results suggest the idea that the soil in our researches accumulates a great quantity of microbial biomass that favorable reflects on soil quality.

The organic fertilizers increase the soil carbon quantity producing conditions for microbial micro-flora development and helping soil improvement.

The crop rotation as technologic element could be considered as an essential source of energy in improving soil properties and as necessary edahon, agreeable to micro-organisms.

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