

ENERGETICAL ASSESSMENT OF THE SOIL BIOTS PARTICIPATION IN HUMUS FORMATION OF THE SEROZEM-MEADOW SOILS FROM NATURAL AND CULTURAL CENOZES

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Abstract

Some consequences of the investigations on soil biots bioenergetics in the Salyan steppe serozem-meadow soils have been performed in the article. The researches were comparatively conducted in the natural cenoze under grassy and saltbushes and agrocenoses of the irrigative grain crops. Studying the bioenergetical indices provides for energy calculation accumulating in a biomass of the invertebrates, microorganisms and humus of soil, and also definition of the summarizing energy accumulated in soil organical substances.

Key words: energy, biomass, soil biot, humus

1. INTRODUCTION

For the profound energetic characteristics of the biological processes the first-degree significance acquires, a definition of the number and biomass from the different components at biogeocenoses and accumulating the sun energy by them. The data availability about energy supplies in accumulating biomass, undoubtedly are important indices of the soil fertility energetic appraisal and besides, the higher each soil type productivity the more energy in it is related with soil humus, microbic mass, invertebrate zoomass and plant residues. It was established that the changes connected with the total biomass creation of the organic matter, and also an energy quantity accumulating in it, the sun energy usage completeness of soil formation at energy accumulation in biogeocenoz biological components submits to the principle of the vertical zonality in soils spreading. As a result of the regular changes of the hydrothermal regime, plant communities productivity, quantity, kind and grouping composition of the invertebrate and microorganisms cause forming quantitatively different biomass and supplies of energy accumulating in these soils organic substances [1;2].

We can come to such a conclusion that the global function of soil cover in biosphere (or in limits of the concrete biogeocenoz) is an accumulation of the humic substance stable complex and the sun energy obtaining as a result of the biochemical transformation in the plant and animal residues.

So far as our investigations related with the soil biots (invertebrates, microorganisms) i.e. heterotrophic organisms we consider that it is worth while to dwell on some judgements in this connection. Development of the whole heterotrophic organism with its food substrates in a complex can be regarded as energetically reserved system in which the decrease of the total supply in this system is always noted.

The heterotrophic synthesis of the food resources as exothermal process of the initial nutritious matters transformation in living cell composite part is accompanied by oxidation, carbon dioxide and energy loss [6].

As a result of biosynthesis from low-calorie substances with the energy secretion the most composite and high calorie combinations are formed, i.e. occurs energy concentration in the synthesis matter.

Consequently, in a process of the biochemical transformation of the plant residues by the participation of the fermentative systems an energy part supplying in phytomass residue is drawn into inside cell needs, but an important part is transformed in humic matters synthesis.

Otherwise an energy quantity definition, transforming by organism in its development process is a main problem of bioenergetics in invertebrates and microorganisms.

An elaboration of the bioenergetical problem must expose ways and forms of the energy transformation in biogeocoenosis, reveal a role of each section in these transformations – their main and indirect making influence on which allow to ensure the most productive usage from the sun ray energy by soil-plant systems.

Under natural conditions of the sun energy for soil formation are related with the physico-chemical, water-thermal, biological processes. In the cultivated soils, i.e. agrocenoses it is necessary to take account of the actual soil humidity (especially, at irrigation), and also agricultural plants productivity. Thus, a relation of the soil formation energy parameters with the economical (agroeconomical) fertility parameters is planned.

2. MATERIALS AND METHODS

For a quantitative appraisal of energy accumulating in soil biota biomass as the investigation objects were selected the natural and cultivated coenoses in the Salyan steppe serozem-meadow soils. The natural coenoses occupied biotops covering by halophyte and mixed-herb vegetation, cultivating versions have been presented by agrocenoses of cereals and Lucerne.

The invertebrates (mezofauna) registration was conducted by M.S.Giliarov's method [3]. The microbiological analyses were realized by N.A.Karsilnikov's method [4]. As an energetical equivalent the averaged indices of the invertebrates [5], microbiota [6] and humus [1] burning heat (1st group substrates) were used.

3. DISCUSSION

The serozem-meadow soils in the Salyan steppe are formed under arid ecological conditions with the dry subtropical climates. These soils main plant formations are salt-mixed-herb. Presence of sorts in a composition of the herb vegetation belonging to cereals, composite flower, cross flower and wormwood testifies transitional stage from the semidesert-steppe and meadow stage of soil formation.

The investigated soils process Loamy-mechanical compositions with the physical clay content 46-60%, lying depth of the subsoil waters is 1,8-3,0 m, with mineralization 2-10 g/l, alkaline environment (pH) reaction is 7,9-8,1. on natural coenosis under halophyte formations the isopoda representatives (1 isopoda) are mainly met: Hemilepistus and Armadillidium (2,4-6,4 ekr/m²), hard-wing insects are attached to salt-plant as Brachydesmus – 2,4 ekr/m², Bulae – 3,2 ekr/m², black-body as Tenturia – 9,6 ekr/m², beetle as Scarites – 1,6 ekr/m², also predatory multi-foot Cryptors – 0,8 ekr/m².

From a total quantity – 26,4 ekr/m² and biomass 2085 mg/m² of the revealed invertebrates falls to isopoda's share - 33,33 %, insects – 63,64% and miriapod – 3,03%. As a result of the life-activity and the following gradual death of invertebrates in their biomass (dry substrate) concentrates till 3413 ccal/m² of energy. The energy significant quantity 1922,25 ccal/m² contains in black-bodies as Tenturia, in isopoda as Hemilepistus and Armadillidium – energetical indices change by 335,74-410,06 ccal/m².

Some less quantity of energy accumulating in biomass of the insect sorts; Brachydesmus 339,30 ccal/m², Bulae 81,81 ccal/m², Scarites 62,82 ccal/m². in predatory multi-foot sorts: Cryptors contain till 260,54 ccal/m² of energy. Thus, in saline biotops the energy transportations are dominant sorts of the insects and isopodas.

The researches being performed on natural coenosis under wormwood-ephemer plant revealed absolutely other energetical indices of the invertebrates. On a quantity 28 ekr/m² the invertebrates outnumber saline biotops, however they are presented by small types of the family: coccinellidae; Tenebrionidae and carabidae, forming comparatively small dry biomass 0,1091 g/m² in which is accumulated – 504,08 ccal/m² of energy. An appearance of Lumbricide the ray process development here.

A significant quantity of energy is accumulated in rain worms – 214,60 kkal/m², then isopoda sort. Protracheoniscus - 119,78 kkal/m² and Armadillidium – 42,70 kkal/m² and insects sort: Coccinella- 123,62 kkal/m². Less of the total energy contains in mollusks – 3,38 kkal/m².

Appropriation of the serozem-meadow soils leads to the cardinal changes of the animal: inhabitant's structure. The invertebrates quantity under cereals forms on average – 20 ekr/m² with biomass – 1,04 g/m².

The invertebrates dominant groups are wood louse (Isopoda) sorts: Protracheoniscus and Deseritio and Lumbricides (Lumbricidae) forming 52%, but 48% from mezofauna total quantity falls to the insects' share. In a dry biomass of 0,3045 g/m² is accumulated – 1469,26 kkal/m² of energy. From this total energy in rain worms is related – 259,13 kkal/m², isopodas – 245,58 kkal/m² and insects - 964,55 kkal/m² of energy.

Study of the microorganisms energy processes an important significance both from stand point of humus formation and at energy definition containing in microbial mass present a definit scientific interest for the soils in the arid ecosystems, especially at comparison of the energetic indices in microbiots from natural and cultivated cenozes.

The microbiological analyses in the natural cenozes soil tests under halophyte vegetation revealed a little total quantity of microorganisms – 760,7000 g of soil. In the grouping content of microbiots a main number falls to actinomycetes – 455000 g of soil or 59,81%. A total number of bacteria is 288,07000 g of soil or 38,0%. The microscopical fungus quantity is relatively little 16,7000 of soil. i.e. totally 2,19% presented by sorts: Aspergillus and Penicillium which methods bear high osmotic pressure of the soil solution.

The results testify that two main factors – high salinization more than 2% and dominating halophyte vegetation depressively influence on microbiots by limiting their life activity. The calculations indicate that in biomass of microorganisms – 1,30 g/m² accumulated – 7,90 kkal/m² of energy.

A main part of energy is related with bacteria 7,01 kkal/m² and only a small part – 0,89 kkal/m² falls to actinomicites and fungus share.

It is known that microorganisms create composite and useful symbiotical connections with the plant root system. In a given case a total quantity of microbiots in a root rhyzosphere of halophytes rises till 813,2000 g of soil biomass accordingly increases till 1,46 g/m² in which some more energy number is accumulated i.e.8,87 kkal/m².

A total number essentially rises in the cultivated soils under irrigative cereals – 2716000 g of soil and biomass 7,86 g/m² of microorganisms.

In comparison with the saline soils in the cereals agrocenoz microbiot biomass a significantly more quantity of energy i.e. 47,76 kkal/m² from which falls to the bacteria's share 42,36 kkal/m², to actinomicite's and fungus share accordingly 5,40 kkal/m².

The indices of the total quantity and microorganisms energy quantitatively change in rhizosphere of cereals. At a total quantity of microorganisms – 2987000 g of soil the biomass is created 8,84 g/m² in which 53,73 kkal/m² of energy is accumulated.

The Sun energy modification accumulated in the plant mass and especially in humus serves the main source of energy for the life-activity in soil biots and various biological and mineral transformations.

Therefore, study of the energy qualitative indices accumulating in humus of soil process an important. Significance for the correct management by soil processes, especially in agrocenozes. It is necessary for keeping of the humus balance on which depends the cultivated soils fertility and agricultural plants v productivity.

The researches of the investigative soils humus condition indicated that a humus total content in the soil of the natural cenoz under halophyte plant changes by 0,54-0,63% in 0-30 cm of layer. The humus mean supply in this layer is 7,58 t/h in which 40·106 kkal of energy or in a calculation of 1m² 4·10³ kkal was accumulated.

The humus supply in root rhizosphere rises till 17,4 t/h, accordingly increases and their energetic indices till 85,106 kkal/h or $8,5 \cdot 10^3$ kkal/m².

In the soil of the natural cenoz under wormwood - ephemer community the humus content changes by 0,71-1,10% from mean supply of humus 11,9 t/h in which $60 \cdot 10^6$ kkal of energy or in a calculation of 1 m² $6 \cdot 10^3$ kkal was accumulated. The humus supply in a root rhizosphere rises till 19,5 t/h, increases an energy connected in it till $97,5 \cdot 10^6$ kkal/h or $9,8 \cdot 10^3$ kkal/m².

On agrocenoses of the irrigative cereals the humus energy essentially changes, totally a content of humus is 2,16%, humus supply in 0-30 cm of layer formed 27,4 t/h in which $135 \cdot 10^6$ kkal/h of energy or in a calculation of 1 m² $13,5 \cdot 10^3$ kkal is accumulated. In the soil of the rhizosphere the humus content and supply formed accordingly 2,20% and 28,6 t/h.

An energy connected in humus rises till $113 \cdot 10^6$ kkal/h which testifies more favourable conditions of the humus formation process in cultivated soils.

From the data it is obvious that the main components participating in humus formation energy on natural and cultivated cenoses are biomass of the invertebrates, microorganisms and plant residues.

CONCLUSIONS

The researches show that in a biomass of the invertebrates on natural cenoses under saline and wormwood – ephemer plant accordingly 3,4 kkal/m² and 0,5 kkal/m² is accumulated 1,5 kkal/m² of energy contains in the invertebrates biomass on cereals agrocenoses.

In biomass of microorganisms from natural cenoz under halophyte plant 7,9 kkal/m² is accumulated, in the microbiot biomass of the cereals agrocenoses significantly more quantity of energy is 47,76 kkal/m².

In humus of soil under halophyte and wormwood – ephemer plant $8,5 \cdot 10^3$ kkal/m² and $9,8 \cdot 10^3$ kkal/m² is accumulated. The energy accumulating in humus of irrigative cereals rises till $13,5 \cdot 10^3$ kkal/m².

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