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BIOLOGICAL ACTIVITY OF SOIL AND RATES OF DECOMPOSITION OF PLANT RESIDUES

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ABSTRACT

This article presents the results of the studies on determining the number of soil microorganisms under crops of crop rotations cultivated with the use of different methods of biologization. its dynamics during the growing season, biological activity of the soil, and the rate of decomposition of plant residues. It was found out that cultivation in combined sowing with perennial legumes, their use in fallows, and the use of stubble sideration provide acceleration of the rate of decomposition of decomposition-resistant plant residues of sunflower. barley and winter wheat, as well as an increase of biological activity of soil: in soil under sunflower (on the background of stubble sideration) by 2.2-3.2 times, in fallows by 1.5-2.0 times, in winter wheat plantings on green fallow by 2.8 times, in binary sowing of winter wheat with alfalfa by 3.2 times.

Disciplinary: Green and Sustainable Agriculture and Crop Farming, Biotechnology, Ecology and Environment Studies, Biology.

1 INTRODUCTION

Agrocoenosis… The plant community was created by a human and characterized by a particular species composition and specific relationships between its components. Why has a human created it? To provide human beings with foodstuff, animal farming with feedstuff, an industry with raw materials, and not just provide, but also obtain high yields of cultivated products at the least labor and means cost. The farmer should indeed aim to obtain high crop yield of good quality under the conditions of resource and energy saving, but is this the only challenge for him? Also, what about the efficient, economically, environmentally, and technologically sound land use, and what about high-quality soil formation with optimal conditions for cultivated plants? But this aspect, unfortunately, is not something that is kept in mind from the beginning. So, what do we have in the end? Degradation of soil fertility to physical: erosion, soil blowing, repacking, etc. Physico-chemical: soil salination, alkalinization, a decrease of absorption capacity of the soil, acidification, and so on, The issue of biological degradation has been particularly of a great concern today, which implies the decline in the organic matter content of the soil, a decrease in the number of soil-inhabiting organisms, impoverishment of their species composition, a decrease in the biological activity of the soil, etc. (Scherbakov, 1994; Litsukov, 2013).

Degradation of soil fertility, which has been currently progressing in most farm units of the Central Black Earth region, raises an urgent issue of solving this problem before agricultural producers and science. Of course, It is not today that this problem has surfaced, and to solve it a great amount of research work has been carried out with a focus on the establishment of various methods to reduce the development of degradation processes (Trofimova, 2018) or to eliminate the reasons of their development, but the problem remains quite relevant these days.

Today an important role in reducing the negative effect of various culture practices on the main indicators of soil fertility is assigned to a re-evaluation of the main elements of the intensive farming system and the development of alternative methods of crop cultivation, taking into account specific edaphoclimatic conditions and economic characteristics. An abrupt transition of agricultural activity to organic farming is currently impossible: it is a long-term process requiring not only a major reorganization of a farming system of a particular farm unit and significant financial investments, but it also requires certain determination on the part of the land-user, his willingness to overcome difficulties at the first stages and the ability to wait patiently for the efficiency of the embodied technologies. Therefore, today the most realistic thing is to practice alternative farming based on ecologization and biologization. on applying such methods while farming, which in addition to maximizing the product yield would prevent diminishing fertility and would not lead to degradation of the natural environment in the agrosphere.

Since 1970th the scientists of Voronezh State Agricultural University have been developing culture practices. which ensures conservation and improvement of soil fertility. Many recommendations and schemes of crop rotation were developed and put into production, as well as systems of land rotation cultivation, farming methods and methods of weed control, recommendations of the studies on the efficiency of the use of a straw, green manure, plant residues, animal manure, defecate as sources of organic matter, methods of improving main indicators of soil fertility: moisture, density, structure, water stability, etc. A great number of studies have been carried out by the scientists from different regions of the country on the determination of the microbiological activity of soil depending on the studied methods of improving soil fertility (Mokiev, 2004; Nadezhkin, 2005; Kuzminykh, 2011; Kolobkov, 2012; Linkov, 2015; Selyavkin, 2015; Gluhikh, 2017; Grinets, 2019; Turusov. 2019).

Over the last decade, research work has been studied the effect on the main characteristics of the soil of combined sowing of industrial and grain crops with perennial legume grasses. The main aim of these studies was to determine the effect of binary sowing of sunflower with perennial legume grasses, placed on the background of joint use on fertilizer of barley straw and stubble sideration of oil radish, on the main soil characteristics in the conditions of Central Black Earth region. At the same time, one of the tasks set by the researchers was to establish the influence of the factors studied on the dynamics and activity of soil microorganisms and the associated rates of the decomposition of plant residues, which is of significant interest for solving a lot of key objectives, including black soil fertility and stability of agricultural ecosystem (Menkina, 2007).

2 RESEARCH METHODS

The studies were carried out in a stationary experiment. on a typical. gumbo. medium black soil. The relief of the site is leveled. hollows or hills are absent. The initial humus content of the soil layer of 0-30 cm is 5.3%. The exchange potassium level of the soil (by Chirikov) is characterized as extremely high (184 mg/kg of soil), and the mobile phosphorus level of the soil is characterized as increased (113 mg/kg). According to the pH of the soil solution (pHsol 5.6), the soils are subacid. The content of hydrolyzable nitrogen is 52.9 mg/kg of soil, and sulfur (S) is 34.1 mg-eq./100 g of soil.

This article presents the results of the studies conducted in 2013-2016 in the Voronezh region. in the Central Black Earth region. which is characterized by a moderate continental climate with relatively hot summers and moderately cold winters. According to the value of the hydrothermal coefficient (HTC) the years of research were characterized by varying degrees of moisture of the growing season: for example. 2013 and 2016 were perhumid (HTC according to Selyaninov was 2.3 and 1.8), while 2014 and 2015 were dry (HTC 0.7 and 0.8 respectively), which made it possible to conduct an overall assessment of the effect of the studied factors on the main biological indicators of soil fertility.

2.1 CROP ROTATION

The design of the experiment:

1) Crop rotation No.1: summer fallow – winter wheat – barley – sunflower/corn
2) Crop rotation No.2: green fallow (melilot of the second year) – winter wheat – barley + stubble siderate oil radish – binary sowing of sunflower with yellow melilot/binary sowing of corn with yellow melilot
3) Crop rotation No.3: sown fallow (alfalfa purple of the second year) – binary sowing of winter wheat with alfalfa purple of the third year – barley + stubble siderate oil radish – binary sowing of sunflower with alfalfa purple/ binary sowing of corn with alfalfa

In all cases, grain crops straw, and sunflower plant residues were used as sources of organic matter. The experiment was conducted according to the field-plot technique (Dospehov, 1985). Crop rotations are represented by all the fields in space and time. The experiment is characterized by the systematic distribution of variants. in three replications. The recorded density of the plot is 525 m_2.

2.2 CROP FARMING IN BINARY SOWING

The technology of the crops farming except for the studied techniques is generally accepted for the Central Black Earth Region. We shall specify some features of the crop farming in binary sowing. While sowing sunflower with perennial legume grasses. it is sown to the depth of 5-6 cm with a sowing rate of 50 thousand germinating seeds per 1 ha. The sowing of the binary component (grass) should be performed on the same day directly into the rows of sunflower to the depths of 2-3 cm (seeding rate is 5 kg/ha). The activities performed referring to the combined sowing of oil crops include carrying out of two inter-row cultivations. After harvesting sunflowers, the remaining stems of the crops and vegetative mass of the grasses are chaffed by the cutter.

Next year. in spring grasses, growing on plots, form fallows: yellow melilot forms green fallow, and alfalfa purple forms sown fallow. In the first stages of the development of the perennial grasses, inter-row crop cultivations are carried out. With the beginning of the phase of the mass blossoming of the melilot, the embedding of its green mass into the soil is carried out with the help of a disker to the depth of 10-12 cm. while the vegetative mass of alfalfa purple is to be used for feedstuffs. The follow-up culture practices carried out on crop rotation plot with green fallow involve maintenance of soil in a clean condition free from weeds, winter wheat sowing, and so on.

Two more procedures of mowing are carried out on the plot of alfalfa purple after the first mowing of legumes: one is full mowing; the second one is carried out immediately before the sowing of winter wheat. Then inter-row cultivation of alfalfa is carried out, and winter wheat is sown across the rows of alfalfa. In spring, when cultivated plants of the combined sowing come into active aftergrowth, the crops are treated with Granstar Pro herbicide (10 g/ha). This practice is necessary to inhibit the activity of alfalfa plants in the grass stand of grain crops and provide favorable conditions for intensive growth and development of winter wheat. During winter wheat harvest corn straw and the remaining vegetative mass of alfalfa are chaffed and evenly distributed over the soil surface. The following varieties and hybrids of crops were cultivated in the studied crop rotations: barley – Vakula, sunflower – Poseidon 625, oil radish – Tambovchanka, alfalfa purple – Diana, yellow melilot– Siberian 2.

2.3 OBSERVATIONS AND TESTS DURING CROPS GROWING PHASES

All planned observations and tests were carried out per the standard methods. Soil sampling was conducted layer-by-layer. every 10 cm to the depth of 30 cm in the following phases of the development of crops:

- sunflower: seedling stage, initial blossom, full maturity;
- winter wheat: spring after-growing, heading stage, full maturity;
- barley: seedling stage, heading stage, full maturity;
- fallows: germination of perennial grasses, their initial blossom, before sowing of winter wheat.

2.4 RATE OF DECOMPOSITION OF THE PLANT RESIDUES

The determination of the rate of decomposition of the plant residues contained in soil on different variants of the experiment was carried out in the following way:

- plant residues are chaffed into segments of 5-7 cm (imitation of cutting by harvesting tool);
- absolutely dry soil that was passed through a 3mm sieve (600 g) and absolutely dry after harvesting residues of the crops studied or their mixtures (15 g) are placed into Capron-mesh bags (size 15x30 cm);
- samples are buried into the soil in triplicate to the depth of 10-20 cm;
- during the period of the studies, the soil surface is maintained in a clean condition free of weeds;
- extraction and washing of samples are performed annually;
- separation of plant residues from the soil is carried out by the method of decantation, by passing of the solution through a 0.25 mm sieve;
- washed plant residues are dried to a completely dry condition and weighed.

2.5 DETERMINATION OF CELLULOSE-DECOMPOSING ACTIVITY

The determination of cellulose-decomposing activity was carried out based on the decomposition level of flaxen linen in the soil (by application method). i.e. by the method of determination of the residual amount of cellulose not decomposed in the soil. This method included layer-by-layer placement in the soil of previously weighed sterile flaxen linen and its extraction a month later. The flaxen linen was carefully washed off the soil and half-life products, then dried and weighed.

2.6 SOIL-INHABITING MICROORGANISMS

The abundance of main physiological groups of soil-inhabiting microorganisms was carried out following standard methods: the main physiological groups of soil microorganisms – according to the methods of All-Russia Research Institute for Agricultural Microbiology by inoculation of soil suspension of certain dilutions on selective culture media (Tepper et al., 1979); the number of ammonifiers on meat-and-peptone agar (MPA); bacteria. assimilating mineral forms of nitrogen and actinomycetes on starch-and-ammonia agar (SAA); the number of soil micromycetes on Czapek's medium. acidified with lactic acid; cellulose-decomposing microorganisms on the Getchenson medium with filters; aerobic nitrogen-fixing organisms were counted on the Ashby medium.

3 DISCUSSION

The main sources of organic matter in soils of agrocoenosises are plant residues of cultivated crops and associated weeds. Further, not only the amount of plant residues entering the soil is important, but also their qualitative composition that determines the decomposition rate in the soil. The rates of decomposition of the studied cultures varied greatly depending on their chemical composition. For instance, during the first year, the decomposition of plant residues of oil radish was more intense at 83.6%, more than 50% of the plant residues of alfalfa purple of the third year was decomposed within the same period (59.4%) as well as yellow melilot of the second year (58.9%). In comparison with the above-mentioned, the rate of decomposition of sunflower stems was somewhat less 45.1%, while straw residues of barley and winter wheat were characterized by the lowest decomposition rates 26.0 and 25.0% respectively (Table 1).

In the second year, the rates of decomposition of the straw of grain crops sharply increased: the increase was 46.9-52.8% abs. It should be mentioned that plant residue of perennial legume grasses. oil radish and sunflower decomposed at a most intensive rate during the first year, while during the second year the intensity of the destruction process decreased. amounting to 18.9-20.7 abs.% for legume grasses, 27.4 abs.% for plant residues of sunflower, and 6.6 abs. % for oil radish green mass. However, by the end of the second year, all plant residues had decomposed by more than 71% (Figure 1). Over the following years, the rate of decomposition of the plant residues significantly reduced.

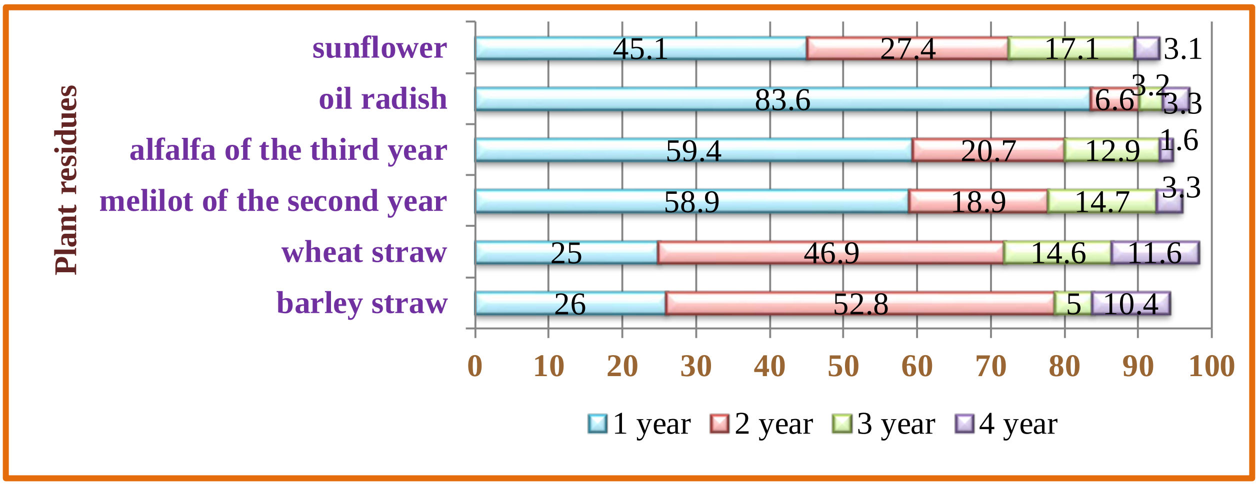

Figure 1: Rates of decomposition of plant residues by year (in percentage).

Table 1: The cumulative rate of decomposition of plant residues of cultivated plants.

Plant residues of cultivated plants	The rate of decomposition, %, for the period			
	1 year	2 years	3 years	4 years
Barley straw (Bs)	26,0	78,8	83,8	94,2
Winter wheat straw (Wws)	25,0	71,9	86,5	98,1
Alfalfa of the third year (A3)	59,4	80,1	93,0	94,6
Melilot of the second year (M2)	58,9	77,8	92,5	95,8
Oil radish (Or)	83,6	90,2	93,4	96,7
Sunflower (S)	45,1	72,5	89,6	92,7

To optimize the conditions of growth and development of cultivated plants it is necessary to perform competent control of destruction processes aimed at achieving maximum decomposition of plant residues by the time for sowing of the following culture. which will ensure the elimination of nitrogen immobilization and negative allelopathic effect on the cultures of decomposition products. The use of stubble sideration and binary sowing with perennial legume grasses in crop rotation allowed us to increase significantly the rate of decomposition of decomposition-resistant plant residues of sunflower. barley and winter wheat. For instance. when embedding oil radish green mass in soil with barley straw the rate of decomposition of the plant mixture was 38% (Figure 2).

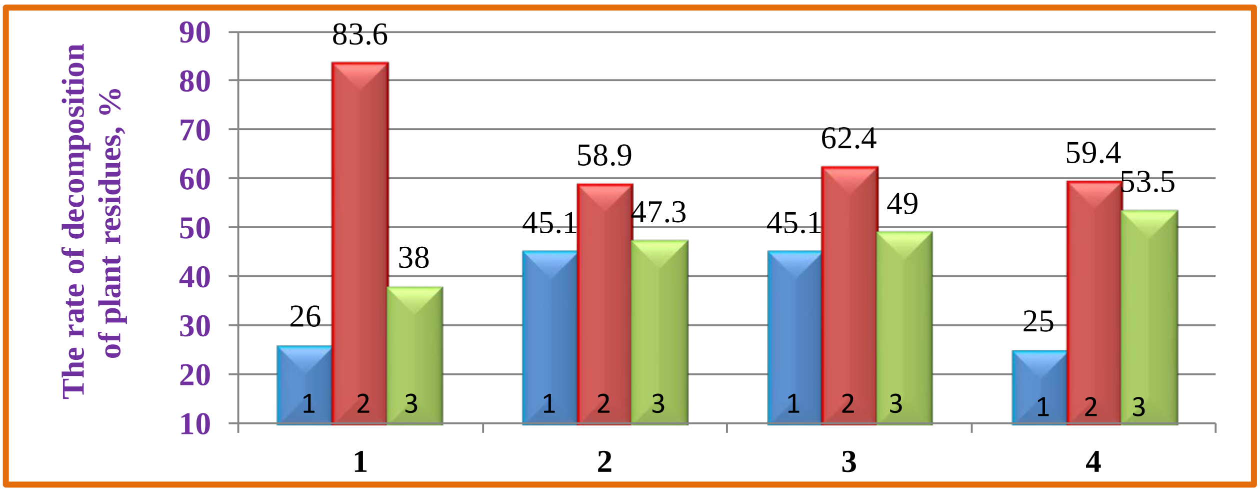

Figure 2: The rate of decomposition of plant residues

Note: 1A – barley straw; 1B – oil radish; 1C – a mixture of barley straw and oil radish;
2A – sunflower; 2B – yellow melilot of the second year; 2C – a mixture of sunflower and melilot;
3A – sunflower; 3B – alfalfa purple of the second year; 3C – a mixture of sunflower and alfalfa;
4A – winter wheat straw; 4B – alfalfa purple of the third year; 4C – a mixture of wheat straw and alfalfa

A more accurate picture of the effect of various culture practices on the rate of destruction of plant residues can be obtained by determining the activity of cellulose-decomposing soil microbiota. Determination of the biological activity of soil was carried out based on establishing the degree and rate of decomposition of flaxen linen.

The studies have demonstrated that biologization practices used in crop rotations have a considerable effect on the activity of cellulose-decomposing microorganisms. which greatly determines the rate of further processes of humification and mineralization of organic matter and change in main soil characteristics (Egorova, 2015). Thus, an introduction of perennial legume grasses into crop rotation ensured an increase of decomposition rate of flaxen linen in soil under sunflower (on the background of stubble sideration) by 2.2-3.2 times, in fallows by 1.5-2.0 times, in sowings of winter wheat in green fallow by 2.8 times, in binary sowing of winter wheat with alfalfa by 3.2 times (Figure 3).

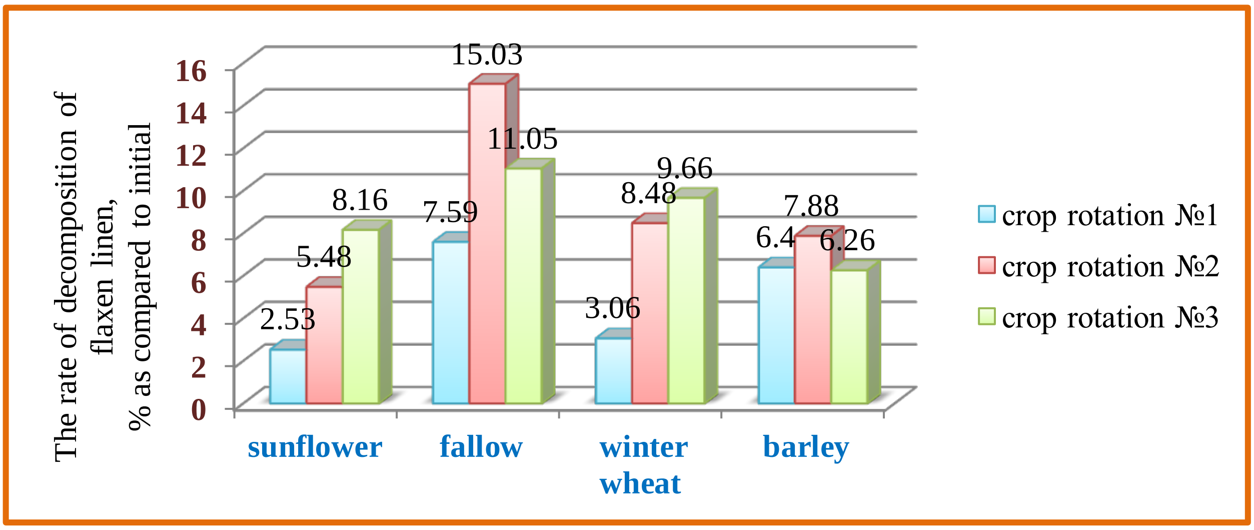

Figure 3: The rate of decomposition of flaxen linen under crop rotation (SSD_{05} – 1.24).

It should be noted. that microbiological activity of soil under multiple cropping was significantly higher than under pure sowings, which is consistent with the results of other researchers as well (Grebennikov. 2008). In soil, under barley crops in crop rotation with yellow melilot, an increase in the rate of decomposition of flaxen linen was the smallest (an increase by 1.48 abs.%), while in crop rotation with alfalfa purple there were no significant deviations from the control.

It should be noted that the rate of decomposition of flaxen linen was directly dependent on the moisture of the growing season: the higher the index of the hydrothermal coefficient. the higher is the rate (Figure 4). This tendency manifested itself both in control crop rotation and in crop rotation with perennial legume grasses.

All soil-inhabiting living organisms are very important in the formation of soil fertility. For example, soil organisms provide primary destruction and breakage of organic residues, thus. repeatedly increasing their surface, while soil microorganisms carry out their further complete destruction. We will examine the dynamics of the number of soil-inhabiting microorganisms as well as their availability in soil depending on the methods being studied both on average during the growing period and separate phases of plant development.

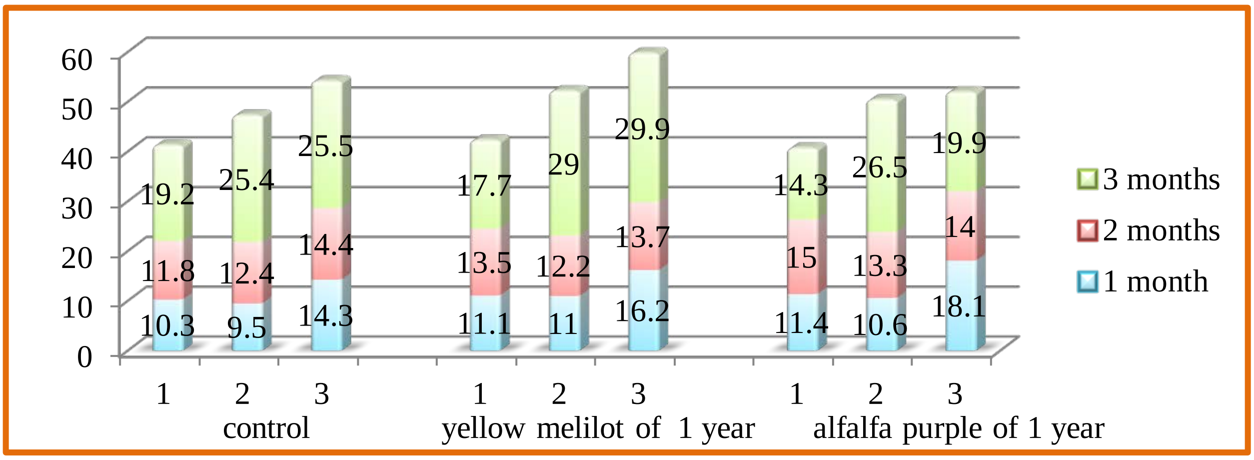

Figure 4: The rate of decomposition of flaxen linen depending on the moisture of the growing season (1. HTC = 0.7; 2. HTC = 0.8; 3. HTC = 1.6)

On average the number of ammonifying microorganisms during the growing season varied greatly, depending on the culture cultivated, as well as on the method of biologization (Figure 6). For instance, in the control crop rotation, this indicator was the highest in winter wheat sowings on summer fallow (5.66 abs. dry soil), while the lowest indicator was in the soil under barley (4.48 mil./g. abs. dry soil). (Note: mil./g. refers to million microbial cells / gram) The number was relatively close in values under pure sowings of sunflower and summer fallow: 5.19-5.23 mil./g. abs. dry soil.

Crop rotation with yellow melilot compared with the control was characterized by a smaller number of ammonifiers under sunflower and a significantly higher number under winter wheat and barley: 6.04 and 5.66 mil./g. abs. dry soil respectively. The number of ammonifying microorganisms in soil under crop rotation with alfalfa purple was significantly higher under sunflower and barley and considerably lower under winter wheat sowings (by 0.8 mil./g. abs. dry soil). As for the fallows, in crop rotation with perennial legumes, the number of ammonifying microorganisms was on par with indicators of summer fallow: 5.09-5.13 mil./g. abs. dry soil. The abundance of this group of microorganisms indicates the conditions of the ammonification of plant residues.

The maximum development of microorganisms that assimilate mineral nitrogen is characteristic of binary sowing of sunflower with perennial legume grasses, where their number amounted to 7.66 and 8.18 mil./g. abs. dry land (Figure 6). Well-marked differences in the number of this group of microorganisms can be also observed under fallows: under sown fallow the number is 2 times less than under summer fallow and green fallow. Also significant differences in the number of microorganisms inhabiting soil layer of 0-20 cm that assimilate mineral nitrogen. can be observed under winter wheat sowings, where the highest values are characteristic of grain crops sowing on green fallow (7.56 mil./g. abs. dry soil) and the smallest values are characteristic of binary sowing with alfalfa (5.92 mil./g. abs. dry soil). The prevalence in the soil of microorganisms of this physiological group under particular crop rotations indicates the rate of mineralization processes in them.

Soil micromyces are an important part of a microbial soil community. The greatest number of micromyces in the spring period is observed under binary sowing of sunflower with melilot (40.5 ths./g dry soil) and under the barley sowing in this crop rotation (50.8 dry soil). (Note: ths./g refers to a unit of measurement for microorganisms i.e., a thousand cells in one gram of soil) During the growing season, by the time of the blooming period, the number of micromycetes in the soil increases: under barley by 170%, under control winter wheat sowing by 53%, under wheat sowing on green fallow by 87%, under binary sowing of sunflower with alfalfa by 107%. Towards the end of the growing season, the amount of micromyces in soil decreases in number, which indicates the slowdown in the rate of the mineralization of plant residues. and most importantly, it indicates that those components of the organic matter, which are hard to reach and poorly decomposable for micromycetes, are included in the mineralization process.

On average, during the growing season crop rotation with yellow melilot is characterized by the highest number of micromyces in soil (Figure 6).

The highest number of cellulose-decomposing microorganisms is characteristic of crop rotations №2 and №3. i.e. crop rotations with the use of the methods of biologization (Table 2). In general. in green manure crop rotation (№2) the highest number of the microorganisms of this group was observed on green fallow (0.72 mil), and in crop rotation with alfalfa purple – in soil, under barley (0.66 mil).

During the blooming period of the main crops, the number of cellulose-decomposing microorganisms was in green fallow (0.68 mil) and sown fallow (0.87 mil) favor. During the third period of soil sampling, associated with the full maturity of cultivated crops sowings and related to winter wheat sowings on fallows, the highest number of cellulose-decomposing microorganisms in soil was under binary sowing of sunflower (0.47-0.63). Thus, the number of microorganisms under sowings of different cultivated plants is determined not only by the cultivated crop but also by the phenological phase of its development.

Table 2: The number of cellulose-decomposing microorganisms in the soil layer of 0-30 cm under crop rotations.

Crop rotation	The number of cellulose-decomposing microorganisms (mil./g abs. dry soil) in different stages of development of cultivated plants											
	seedlings, spring after growing				Blooming				full maturity, before winter wheat sowing			
	sunflower	fallow	winter wheat	barley	sunflower	fallow	winter wheat	barley	sunflower	fallow	winter wheat	barley
№1	0,54	0,44	0,58	0,37	0,61	0,48	0,54	0,58	0,37	0,37	0,20	0,54
№2	0,59	0,72	0,39	0,53	0,66	0,68	0,48	0,52	0,47	0,42	0,27	0,26
№3	0,63	0,38	0,61	0,66	0,44	0,87	0,52	0,58	0,63	0,42	0,31	0,32

Figure 5 demonstrates the dynamics of the number of cellulose-decomposing microorganisms during the growing season of the crops cultivated in various crop rotations.

By the blooming phase of the oil crop, the number of the group of the microorganisms reviewed under pure sowing and binary sowing of sunflower with yellow melilot had increased (by 12-13%). and by the full maturity phase had sharply decreased: by 31% compared to the initial number under control sowing and by 20% under combined sowing with melilot (Figure 5). On the contrary. the combined sowing of sunflower with alfalfa purple was characterized by a decrease in the number of cellulose-decomposing microorganisms by the blooming phase (by 30%) and an increase by the end of the growing season up to the initial indicator.

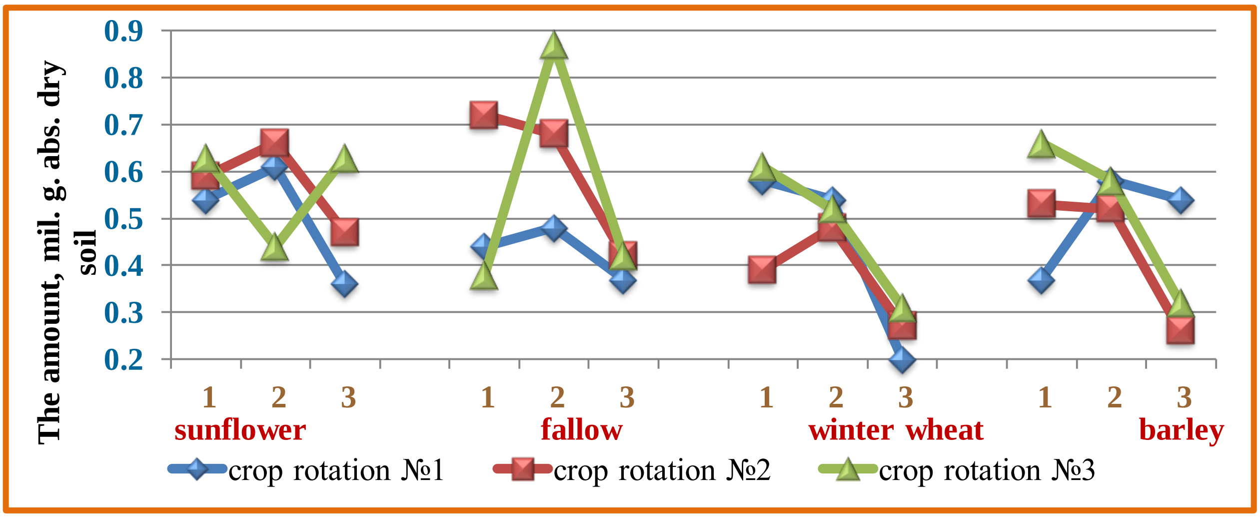

Figure 5: The dynamics of the amount of cellulose-decomposing microorganisms under the cultures of crop rotations during the growing season of crops (1 – seedlings or spring after-growing; 2 – blooming; 3 – full maturity. in fallows – before winter wheat sowing).

A slight increase in the number of cellulose-decomposing microorganisms in summer fallow was observed towards the phase associated with the blooming of legume grasses (by 9%), subsequently. their amount in the soil decreased and by the winter wheat sowing amounted to 84% of the initial indicator. In green fallow, the number of cellulose-decomposing microorganisms during spring after-growing of melilot was the highest 0.72 mil./g. abs. dry soil, which during the growing season tended to decrease: all in all, the number of microorganisms of the group reviewed decreased by 42%.

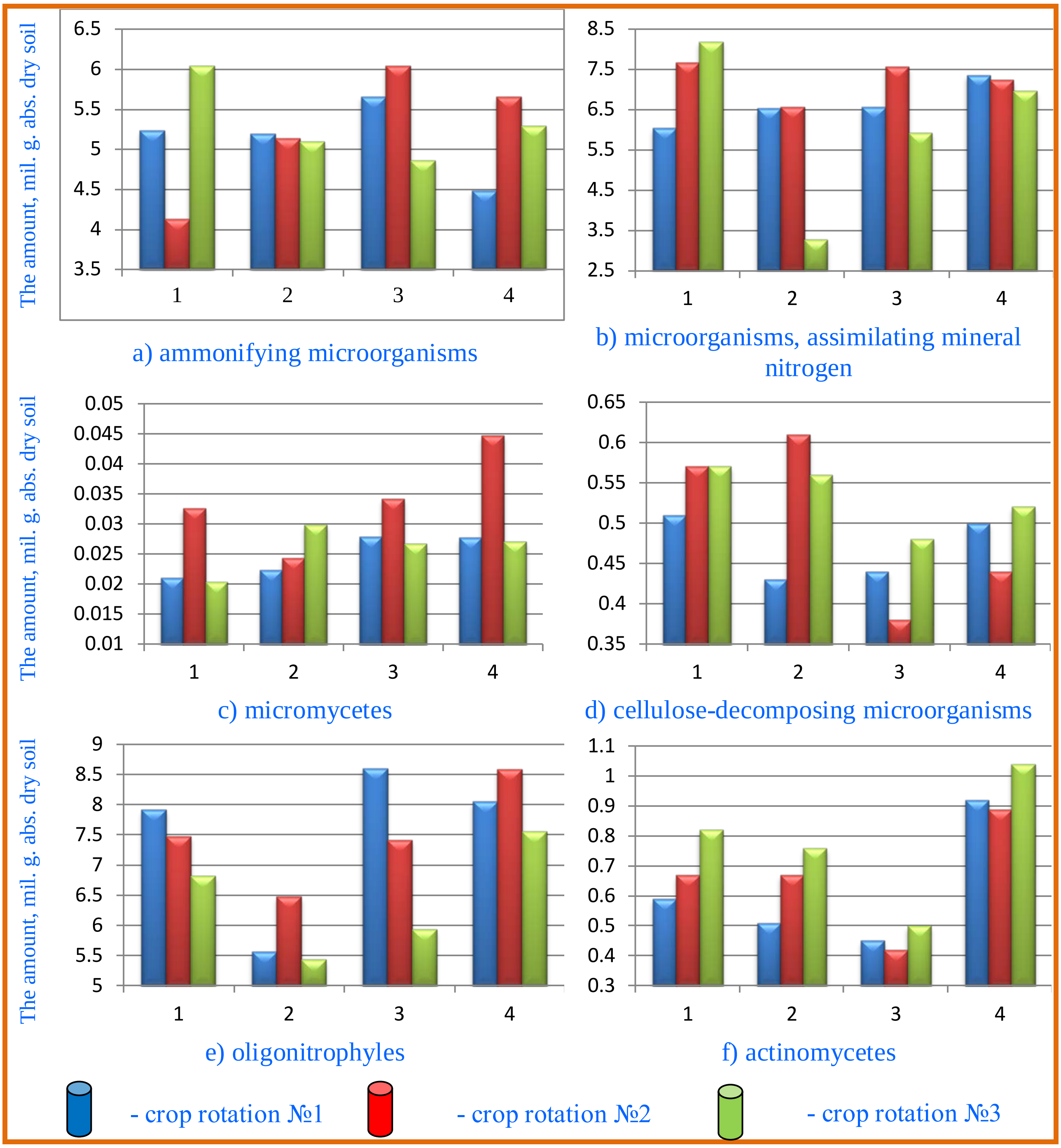

Figure 6: Different groups of microorganisms in the soil of crop rotations, mean indicator over the growing season, soil layer 0-20 cm (1– sunflower; 2–fallow; 3–winter wheat; 4–barley)

The dynamics of the number of cellulose-decomposing microorganisms in the soil of a fallow with alfalfa purple was characterized by the abrupt character: a significant increase by the blooming phase (by 2.3 times) and a sharp decrease in number by the sowing of winter grain crops. Although it should be noted, that during the growing season the number of cellulose-decomposing microorganisms in this variant increased by 10%.

The soil under winter wheat was characterized by a decrease in the number of cellulose-decomposing microorganisms by the end of the growing season in all the variants studied: in binary crop sowing by 49%, when placing crops on summer fallow by 65% (the final indicator of the amount in this variant was of the minimum value throughout the whole experiment). The placement of winter wheat on green fallow initially ensured an increase in the number of cellulose-decomposing microorganisms (by 23%), and then its decrease by 44%, as a result, this indicator amounted to 69 % of spring values by the full maturity of crops.

Under barley sowings, only the control variant was characterized by an increase in the number of cellulose-decomposing microorganisms by the end of the growing season of grain crops: an increase in value amounted to 46%. For variants of placing crops in crop rotations with perennial legume grasses, the number of cellulose-decomposing microorganisms decreased almost by 2 times. On average, during the growing season, the maximum number of cellulose-decomposing microorganisms is observed in crop rotations with perennial legume grasses (Figure 6). For example. their amount exceeds control indicators by 12% under binary sowing of sunflower, by 30-42% under fallows, by 9% under binary sowing of winter wheat with alfalfa, and by 4% under the following sowing of barley.

A considerable specific gravity in the microbial community of black soil is occupied by microorganisms, which can develop at a very low level of nitrogen-containing substances in the soil. that is oligonitrophyles, microorganisms that complete mineralization of organic compounds. Most of them are not characterized by cellulose-decomposing activity. that’s why they widely use immediate products of cellulose destruction.

On average, during the growing season of the cultivated plants, the highest amount of oligonitrophyles is observed under pure sowing of sunflower and winter wheat. placed on summer fallow (Figure 6). When introducing yellow melilot into crop rotation the number of microorganisms of this group increases in fallow compared to the control variant (by 16%) and under barley sowing (by 7%). In crop rotations with alfalfa purple, the average number of oligonitrophyles over the growing period under all crops was lower than under all other crop rotations studied.

Actinomycetes, characterized by the ability to decompose various carbon-containing compounds, have an important role in the process of decomposition of organic residues. The number of these microorganisms in black soils is small: in our studies, on average, over the growing season it varied from 0.42 mil./g, dry soil under winter wheat on green fallow to 1.04 mil./g, dry soil under barley sowings in crop rotation №3 (Figure 6). During the growing season, from the seedling stage up to the blooming stage, as decomposition-resistant organic was involved in the process of humification, the number of actinomycetes in soil increased: under binary sowing of sunflower by 1.5-2.3 times, under barley crop rotation with biologization practices by 1.5 times, under fallows with perennial legume grasses by 1.2 times.

4 CONCLUSION

The introduction into crop rotation of perennial legumes as binary components and fallow-grown crops provides an increase in the number of soil-inhabiting microorganisms. an increase of biological activity of soil and acceleration of the process of decomposition of organic matter, which has a favorable effect on the forming of optimal indicators of soil fertility.

5 AVAILABILITY OF DATA AND MATERIAL

Information can be made available by contacting the corresponding author.

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