

## ESTIMATION OF EFFICIENCY OF SOIL-PROTECTIVE SYSTEM WITH USE OF BIORESOURCES OF AGRICULTURE ON THE BASIS OF USE OF AGROCENOSIS ON THE GREY FOREST SOILS

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### Abstract

*The experimental data of long-term researches establishing high efficiency of soil-protective system of agriculture with use of bioresources on biological and humus in condition of arable grey forest soil has been presented.*

**Key words:** *agrocenosis, farming system, grey forest soil, use of bioresources*

### INTRODUCTION

In modern agriculture in the conditions of the deficiency of organic and mineral fertilizers proceeding falling of fertility of arable soils the problem of an intensification of use of the biological factors, which role in reproduction of soil fertility is especially actual, preservation of stability and efficiency increase of agro-ecosystems is often underestimated. In the advanced economy of the Vladimir area in last time the ways and methods of agriculture proving viability and efficiency successfully take root in practice [1].

Within 20 years on grey wood soils in Yuryev-Polish State Experimental Station for testing varieties (SESTV) the agriculture system is applied soil-protective, allowing receiving stably high grain yields of cultures at the expanded reproduction of soil fertility:

- the agriculture system provides a heavy use of the biological factor in reproduction of fertility of soil and optimization of a food of plants and includes a complex of the agro-receptions as much as possible adapted for a natural course soil formation processes and functioning of ecosystems;
- optimum combination and alternation of grain and forage cultures in crop rotation structure: steam pure - winter cereals on grain - summer cereals on grain - annual grasses (cereal-legume mixtures) with over seeding a clover on green manure - a clover of 1 of the

item - a clover of 2 of the item - winter cereals on grain;

- decrease in volumes of application of mineral fertilizers with use organic (50-100 t/hectares of covering manure) and bioresources (straw of all grain crops of a crop rotation, on the average 20 t/hectares for rotation);

- energy-saving processing of soil with loosening chisel plow to depth 30-40 sm.

The role and value of crop rotation increases in modern conditions with rational alternation of cultures, as leading link of system of agriculture, the major factor of management of material-energy flows and regulations of level of productivity in agro-ecosystem.

### MATERIALS AND METHODS

Grain-grass rotation from 25 % of long-term bean grasses, 12.5 % of an annual cereal-legume mixtures, 50 % of winter and summer grain crops on Yuryev-Polish SESTV creation by the predecessor of optimum conditions for the subsequent culture provides, performance soil-protective functions, increase in a share of biological nitrogen, in a food of plants and soil stocks.

### RESULTS AND DISCUSSIONS

For rotation 8-full a crop rotation with root and stubble the rests grain and forage crops in

soil (on 1 hectares) comes back nearby 48 t a solid, 667 kg of the nitrogen, almost which half are biologically fixed, 196 kg of phosphorus, 410 kg of potassium, that almost in 2 times exceeds quantity of elements of the food brought with mineral fertilizers (Fig. 1).

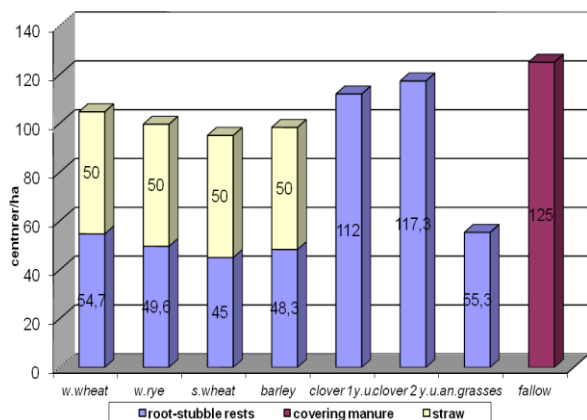


Fig. 1. Receipt a root-stubble of the rests, covering manure (solid), straw in grain-grass a crop rotation on Yuryev-Polish SESTV

In 1970-1985 from 320 kg/hectares NPK brought in fields Yuryev-Polish SESTV to 202 kg or 63% it was necessary on share of mineral fertilizers. Since 1986, in 1st rotation grain-grass a crop rotation after transition on new soil-protective agriculture system, volumes of application of mineral fertilizers have been considerably reduced (about 103 kg/hectares of active substance), manure entering has increased to 100 t/hectares (a ameliorative dose) and there has been begun use of straw of all grain crops of a crop rotation on fertilizer (in compare 2,5 t/hectares annually). The expanded reproduction of organic substance and restoration of the lost agro physical properties of arable grey wood soil was the Overall objective of these receptions.

Now application of covering manure is reduced to 50 t/hectares, doses of mineral fertilizers in different years, depending on a condition of crops, vary from 40 to 110 kg/hectares kg of active substance, and their share in total amount of entering NPK averages 28.2 %.

Straw of grain and leguminous cultures is one of the cheapest, considerable on the volume,

annually renewed, not demanding special expenses for manufacture, transportation and entering, a resource of organic substance and food elements. In agriculture system on Yuryev-Polish SESTV on fertilizer all straw of grain crops of a crop rotation is used, 4 is multiple for rotation 8-full grain-grass a crop rotation. It is crushed and Don-1500 with hinged grinders is in regular intervals distributed on a surface weeding simultaneously with cleaning of grain by combine CK-5.

Use of straw of the cereal cultures having the wide relation of carbon to nitrogen ( $C : N = 80-100$ ), on fertilizer can be accompanied by display of a collateral negative effect of reduction of the maintenance of mineral nitrogen in the arable layer, connected with it immobilization the micro flora participating in decomposition of organic substance of straw, to the sizes negatively influencing for a crop. For optimization of a nitric food and indemnification immobilized nitrogen in system entering on the crushed straw of urea from calculation of 10 kg of active substance is provided N on 1 t straw.

Influence of straw on a crop of agricultural crops is substantially defined by time and its way incorporation. Negative action of straw marked sometimes on growth and development of plants decreases or is completely eliminated, if by the crops moment there have passed the first initial stages of its decomposition. In this case toxic action of products of decomposition of straw and negative effect immobilization of mineral nitrogen is eliminated.

On heavy loamy soils it is recommended to close up straw in top, most aerated, biologically active layer at once after cleaning of grain and straw crushing. In this case for warm enough and damp autumn period phytotoxic phenolic acids decay and to the beginning of spring sowing process remobilization nitrogen, immobilization in microbial plasma that eliminates possible decrease in a crop begins.

The crushed straw after entering of a compensating dose of nitrogen is closed up in top (0-12 cm) a layer of arable horizon by

heavy disk harrows of heavy disk harrow (BDT-3). After passage of the first stages of decomposition in 20-40 days chisel plow PCh-2.5 on draught T-150 is spent.

According to the received data, long application systems with regular incorporation in an arable layer of all crop of straw of grain crops of a crop rotation promoted optimization of indicators of fertility of grey wood soil (as a control variant of comparison the system of agriculture standard for the Vladimir region which took root on this field in 1968 - 1985 is taken). So, essential distinctions in level of biological activity of arable horizon of grey wood soil of a control site and a site with application agriculture systems are established.

The arable layer of soils was characterize stably by higher, than at traditional system of agriculture, indicators of number of all considered groups saprophytic microorganisms: ammonifier, amilobacter, cellulose-fermenting, nitrifying, non-symbiotic nitrogen fixer, and also maintenances of a microbic biomass (Cmb) and total biological activity (Fig. 2)

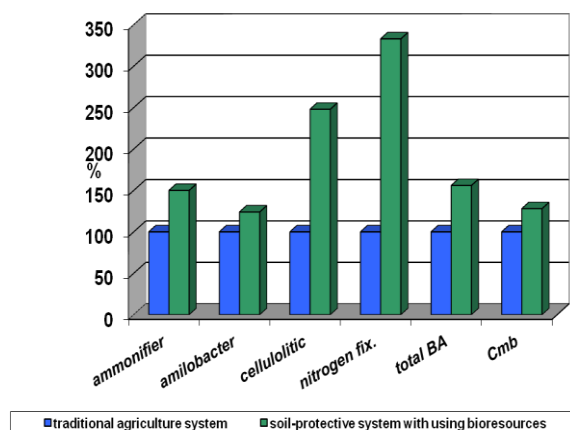


Fig. 2. Indicators of a biological condition of an arable layer of grey wood soil

Special interest number indicators cellulose-fermenting represent the microflorae which increase, as a rule, testifies to optimization soil agrochemical and physical properties and fertility as a whole [2]. Our researches have shown, that in a variant of long use agriculture systems with use of bioresources the arable layer of earth is characterized not

only much higher (in 2,5 times) by number cellulolytic microorganisms, but also more various and their favorable specific structure. Prevalence here bacteria of sort *Cytophaga* testifies to high degree richness soils accessible for saprophytic microflorae organic substance.

According to the received experimental data, studied the system with use of bioresources with regular incorporation an arable layer of straw of all grain crops grain-grass rotation stimulates development anaerobic nitrogen fixing microorganisms *Clostridium pasterianum*. Their number in an arable layer of grey forest soil averages 15 thousand colony forming unit (CFU) in 1 g soils, whereas on sites, where the traditional system of fertilizer (without use of the vegetative rests on fertilizer, with low doses of manure), this indicator essentially more low, its size - at 4.5 thousand level CFU/g soils was applied.

Use of all straw of grain crops on fertilizer allows observing the law of "return" of organic substance. So, about 20 t/hectares of straw for crop rotation in soil arrive nearby 8 T carbon of the organic connections created as a result of photosynthetic activity of grain crops.

The analysis of humus balance in a studied crop rotation has shown that till 1986, prior to the beginning of development soil-protective agriculture systems, it was characterized by negative sizes that have been caused, mainly, low indicators reimbursement balance articles. The expense of humus on a mineralization of nitrogen and crop formation exceeded during this period its receipt at the expense of organic fertilizers and a root-stubble of the rests of cultures in 1.25-1.28 times (Table 1).

In 1st rotation from the beginning of introduction of new system of agriculture (1986-1993 of) mid-annual humus arrival at the expense of organic fertilizers (covering manure and straw grain) has increased almost in 3 times, and humus balance has made +1278 kg/hectares. In 2nd and 3 rotation manure entering has been lowered to 50 t/hectares, quantity a root-stubble of the rests has increased at the expense of increase in

crops of basic production on 11 (1994-2001) - 69 % (2002-2007), and the humus balance is characterize now by positive sizes +205 ... +181 kg/ha.

Table 1. Balance of humus in soil, mid-annual indicators for grain-grass rotation, t/ha

Balance articles	Years				
	1968-1976	1977-1985	1986-1993	1994-2001	2002-2007
The expense	1163	1212	1347	1437	1614
Arrival, including:	907	966	2625	1642	1795
- debris rests	583	543	591	657	990
- organic fertilizers (manure and straw)	324	423	2034	985	805
Balance	-256	-246	+1278	+205	+181

Despite lacking row crops, the positive humus balance in grain-grass rotation is provided only with long-term bean grasses (a clover of 1st and 2nd year of using). For 2 years of cultivation their contribution to humus formation makes 2337 kg/hectares (26.6 %), at the expense of manure (50 t/hectares) in soil is formed about 3000 kg/hectares of humus or 34.2 %, for the account humification straw of grain crops - 3440 kg/hectares, or 39.2 % from total humus formed.

In 1984 the humus average maintenance in an arable layer of grey forest soil on fields made 2.6 % with considerable fluctuations from 1.6 to 5.0 % that specifies in the considerable agrochemical heterogeneity of a soil cover which are caused by integrated approach and being one of essential factors limiting productivity.

The data received in 2006, have shown increase in the humus average maintenance in an arable layer till 3.17, its variation thus has essentially decreased, the minimum value has made 2.65, maximum - 3.86 %.

Studying of qualitative structure of soil organic substance has shown, that the applied system of agriculture with rational use of bioresources not only has raised the maintenance of humus, but also optimized it agronomy valuable indicators: promoted a new growth and accumulation of labile forms humus substances (carbon labile humus - in 1.45; extracting hot water carbon - in 1.83; mort mass - in 1.33 times), capable to fast

transformations and supply of plants by nitrogen and other elements of a food, and closely correlating with productivity of plants (Table 2).

Table 2. The maintenance of labile forms humus substances in arable grey forest soils

Option agriculture system	C org., %	Ceh w	Clh (0.1 m Na P O <sub>4 2 7</sub> pH = 7)	C alkaline (0.1 n NaOH)	mort mass, C g/hect are
Traditi-onal	<u>1,51</u> 100	<u>300</u> 2.0	<u>1550</u> 10.3	<u>2170</u> 14.4	<u>1800</u> 4.0
Soil - protective	<u>1,84</u> 100	<u>550</u> 3.0	<u>2250</u> 12.2	<u>3110</u> 16.9	<u>2400</u> 4.3

Below the line – content in Corg., %

These humus forms as show the experimental data received by many researchers, define speed and capacity of biological circulation, fund of accessible elements of a food of plants, serve as the basic energy source for realization of microbiological processes, including, nitrogen fixation, support a favorable physical (structural) condition of soils.

## CONCLUSIONS

Thus, results of scientific researches and long-term practical experience of application soil-protective systems of agriculture with rational use of agrocenosis bioresources on Yuryev-Polish SESTV have shown its high efficiency concerning optimization of humus indicators and a biological condition of arable grey forest soil.

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