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PRESERVATION OF SOIL FERTILITY AS A BASIS FOR IMPROVING THE EFFICIENCY OF MANAGEMENT IN THE SOUTHERN STEPPE OF UKRAINE

Introduction. Successful work of the farmer consists primarily in obtaining sustainable productivity of crops and preserving soil fertility – the most important and unique natural resource and the main means of production and the basis of life of all living things on Earth. It is the fertility of the soil and the conditions of management that determine not only the amount of the grown crop, but also the indicators of its quality, the state of the ecological environment. At the same time, in modern conditions of the agricultural sector of Ukraine, there is an urgent need to restore natural ecosystems, maintaining their biological balance at a level that will guarantee the stability of the environment, protection of land from degradation, erosion and loss of fertility.

The area of agricultural lands of Ukraine is one of the largest among the countries of Europe, and their qualitative composition and biological productivity are the richest in the world. We believe that in Ukraine is fertile soils dominate, but unfortunately, recently we have seen their depletion, deterioration of basic properties, loss of productive capacity. These negative changes are mentioned by the researchers of Ukraine. After all, as academician of RAN H.V. Dobrovolskyi noted, the processes of destruction and degradation of the ground cover are non-renewable and determine the development of the ecological situation, which the scientist called a quiet crisis of the planet [1].

Among the problems in the agricultural sector the most important one is to ensure sustainable agriculture, increase its productivity by raising soil fertility and the ability to form a guaranteed crop yield with high quality.

Results. In order to maintain soil fertility in the southern Steppe zone of Ukraine, according to the results of research, 7-8 tons of organic and 80-100 kg of mineral fertilizers should be applied to each hectare of agricultural land and, accordingly, 12-15 tons and 240-260 kg - under irrigation conditions. Such a number of fertilizers in

recent years are not added, and crop production is formed mainly due to the residual reserves in the soil of nutrients and mineralization of humus, so that its content is reduced, the soils gradually get worse, depleted and degraded. This requires an urgent response of agricultural producers, because if it is impossible to restore the spent resources, the degradation processes become irreversible [2,3].

So, modern agricultural use of land requires the development and justification of agricultural and reclamation activities aimed at the preservation and reproduction of soil fertility. This leads to the need for research to predict changes in quantitative and qualitative indicators of natural factors of fertility, patterns of direction and speed of soil processes. It is necessary to effectively and continuously monitor the state of soil fertility, the degree of its erosion, the reaction of the environment, the salt regime of the soil. Recently, such processes as soil contamination with heavy metals, radionuclides, pesticides and other toxicants have also caused concern [4]. Depending on the intensity of land use, including irrigation, soil fertility and the environmental situation in general change.

The most cheap, affordable and cost-effective way of addressing improvement of soil fertility and increasing crop yields is the introduction into production of science-based crop rotations, which due to plaintive-root residues enrich the soil with organic matter, and in case of the selection of legumes it is also free source biological nitrogen. Reasonable alternation of crops improves water and nutrient regimes of the soil, reduces contamination of fields, the presence of pests and pathogens, that is, it contributes to the preservation of ecological balance and rational use of agricultural land [5].

Unfortunately, in recent years, the structure of crop rotations is significantly violated. Thus, during the period 1990-2015 in Ukraine there was a redistribution of acreage under crops, in particular: acreage of forage crops decreased by 4.6 times, which adversely affected the development of forage and livestock industry. During this period, the area under crops of highly profitable export – oriented crops has increased significantly: sunflower – by 2.8 times, rapeseed – by more than ten times, which violates the system of crop rotation and leads to complete depletion of the soil cover and its drying. On the contrary, the acreage under potatoes and vegetables and melons decreased by 5%; now they are concentrated mainly in the private sector.

The main problems of the crop industry, in our opinion, are related to:

- expansion of acreage for cultivation of soil crops-sunflower and rapeseed;
- reduction of crops of fodder group, including perennial grasses, in particular alfalfa, individual cereals (millet, buckwheat), legumes and sugar beet;
- low yield of crops compared to other countries in which their high productivity provides the use of modern innovative and resource-saving technologies;
- concentration of production of fruits and vegetables in households that do not

have appropriate storage facilities and conditions for its storage;

- lack of infrastructure for the sale of such products through fruit and sheep farms;
- high energy and resource costs of crop production;
- lack of innovative approaches to modern methods of tillage and cultivation of crops (systems No-Till, Mini-Till, Strip-Till, organic production, drip irrigation);
- a certain shortage of highly skilled workers who are able to work with the latest means of labor and use high-tech operations for growing crops;
- insufficient return of nutrients to the soil, which does not allow to maintain and improve their condition and ability to form crop yields.

Soil fertility is particularly improved due to inclusion grain legumes in the selection of crops in crop rotations. They have a biological feature to form active complexes with soil microorganisms, which bind a significant amount of nitrogen from the air in the process of nitrogen fixation. It is known that during the growing season legumes, depending on the moisture conditions, accumulate from 60-70 to 150 kg of nitrogen. To meet the needs of plants in this amount of nitrogen is necessary to make 200-500 kg / ha of ammonium nitrate. In addition, symbiotic nitrogen fixation has a much higher economic efficiency than the cost of mineral fertilizers. The nitrogen fixed by legumes is used by plants for several years in full, and is not lost as from mineral nitrogen fertilizers. In the root zone legumes produce an active complex of microorganisms that grow very quickly and divide, resulting in the accumulation of organic matter, which eventually turns into humus substances [5]. Additionally, the root allocation of legumes are capable of dissolving phosphates and increase the assimilation of phosphorus compounds [6]. In general, soil enrichment with organic matter improves plant nutrition with minerals in an accessible form, the soil acquires a dynamic balance.

The research was carried out on dark chestnut soil and southern chernozemic soil which is typical for the South of Ukraine on the fields of the Institute of irrigated agriculture of NAAS and Mykolaiv National Agrarian University according to the generally accepted methods of experimental work.

It was found that in the dark chestnut soil in the area of the Ingulets irrigation system, during four rotations of 7-field rotation with alfalfa, the share of which is 35.7% annually loss of humus from the arable layer of the unfrozen soil is 70-90 kg/ha, and during irrigation they were bigger. In case of complete fertilizer of each rotation crop (in doses that are recommended for the zone) humus content in irrigated soil is stabilized, and through the use of once per rotation and even 80 t/ha of half-decay manure it even grows (Table 1).

The deficit in organic fertilizers in the absence of pus in sufficient quantities in crop rotations should be covered by post-harvest residues and by using by-products of crops for fertilizer. The role of organic fertilizers is extremely important in the

preservation of water-physical properties of soils. Without their use, it is compacted, its water absorption capacity deteriorates, the number of water-resistant units decreases. According to our three years of research non-fertilized dark chestnut soil per hour absorbs 14.72 mm of water at green manure in the year of effect and aftereffect, the proportion rose to 16.3-20.6 per cent, and straw – 22.8-34.6 per cent.

Table 1 Humus content in 0-30 layer of dark chestnut soil under the influence of long-term use of fertilizers in irrigated crop rotation

Experience option	Humus content, %		Loss or increase of humus	
	for the period of experience	after the 4th rotation of the crop rotation	in absolute percentage	average annual, kg / ha
Without fertilizer	2.26	2.11	-0.15	-277.5
P_2O_5	2.26	2.19	-0.07	-129.5
N	2.26	2.23	-0.03	-55.5
NPK	2.26	2.25	-0.01	-13.5
NPK +80 т/ ha of manure 1 time per rotation of crop rotation	2.26	2.35	+0.09	+166.5

We have determined that for the incorporation of straw into the soil, even in dry years, moisture accumulates in the arable layer by 15-20% more than without it. This should oblige producers of agricultural enterprises in any case not to burn straw, and to use all post-harvest residues for soil enrichment with organic matter. In addition, each ton of straw put in the soil is equivalent to 4-5 t / ha of manure by the amount of dry organic matter introduced.

Many researchers determined that the amount of by-products, which can be used as fertilizer after harvesting the main crop equals on average to 5-6-10 t/ha. All macro - and micronutrients go with it to the soil. So, wheat straw on 1 hectare produces on average 20 kg of nitrogen, 10 kg of phosphorus and 30-35 kg of potassium, with the remains of corn 45; 18 and 100 kg, and sunflower – 40; 20 and 130 kg respectively. In addition, by-products of agricultural crops contain calcium, magnesium, sulfur and all trace elements. It is also known that the decomposition of crop residues depleted to nitrogen is significantly accelerated by adding, for example, to straw 7-10 kg/t of the active substance of nitrogen or modern biodestructors of stubble [7].

The calculations determined that the use of crop residues and straw, compared with manure, can save on each hectare up to 170 kg of diesel fuel and 15-17% of cash costs.

It is known that without the use of organic and mineral fertilizers to a greater extent irrigated soils, which are formed significantly higher levels of crop yields would deplete and, accordingly, the removal of nutrients will significantly increase. Our

studies have found that the use of organic fertilizers has a positive effect on the main elements of soil fertility in the link of irrigated grain-vegetable crop rotation (corn, winter wheat + post-harvest, tomatoes). Under the influence of straw and green fertilizer, and especially when using both types the content of organic matter, total and water-soluble humus in the soil increases (Table 2).

Table 2 The content of humus and organic matter in the arable layer of dark chestnut soil in the link of irrigated grain-vegetable crop rotation (under tomatoes, average for 3 years)

Experience option	Term of determination	Content		
		organic matter, %	common humus, %	water-soluble humus, mg / 100g
N_{120} P_{90} K_{60}-background	1	6.64	2.00	17.99
	2	7.21	2.04	25.81
Background+green fertilizer	1	6.81	2.02	18.86
	2	7.27	2.06	26.46
Background + winter wheat straw	1	6.82	2.03	18.42
	2	7.31	2.08	25.39
Background+green manure+straw	1	6.91	2.04	19.02
	2	7.38	2.09	27.16
HIP_{05}		0,22-0,27	0,01-0,03	1,12-2,47

Note:[*)] Term of determination: 1 – for the period of sowing-rising; 2 – when harvesting.

The latter, as it is known, characterizes the presence of organic substances in the soil at the primary stages of mineralization. Over time, these organic substances in the process of decomposition will turn directly into humus.

The use of straw of grain crops as an organic fertilizer was also studied on the southern chernozem in various parts of the crop rotation in the cultivation of drought-resistant crop without irrigation (Table 3).

It was established that in the conditions of rain – fed agriculture straw effectively affects the main indicators of soil fertility-the content of humus, organic matter, mobile forms of phosphorus and especially potassium, its structural indicators, microbiological activity and the like. In addition, as it is shown in table 3, the grain yield levels for the combined use of straw and $N_{60}P_{40}$ are formed above the control, but slightly inferior to mineral nutrition. This is due to the fact that for the decomposition of straw, nitrogen fertilizer addition was not made, and due to increased mineralization of organic substances cellulose-desructive microorganisms that use the nitrogen to decompose organic matter.

Table 3 Influence of fertilizers and predecessors on grain yield of soriz, t/ha

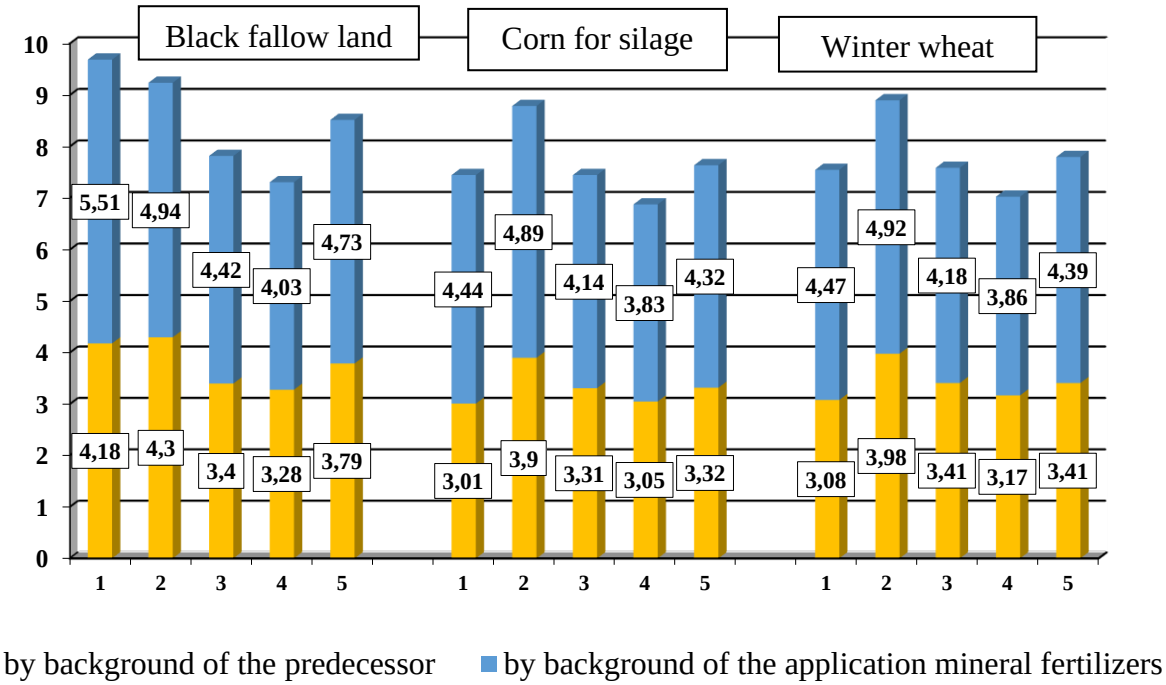
Crop rotation chain (factor A)	Feed backgrounds (factor B)								
	Without fertilizer			Straw + $N_{60}P_{40}$			$N_{60}P_{40}$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
pea – barley – soriz	4.26	3.18	3.30	5,29	4,41	4,50	5,42	4,55	4,61
sunflower-winter barley-soriz	4.05	2.98	3.11	5,00	4,09	4,16	5,14	4,22	4,28
corn- winter barley -soriz	4.06	3.01	3.13	5,17	4,23	4,30	5,27	4,33	4,40
winter barley-corn-soriz	3.95	2.88	3.02	4,92	3,93	4,12	5,12	4,16	4,24
winter wheat-sunflower-soriz	3.81	2.70	2.82	4,82	3,92	4,10	5,09	4,11	4,20
Factor B average	4.03	2.75	3.08	4,84	4,12	4,24	5,21	4,27	4,35
HIP_{05}, t/ha	2004			2005			2006		
Factor A	0.071			0.051			0.12		
Factor B	0.084			0.098			0.19		
Interaction of factors AB	0.130			0.270			0.21		

It should be noted that organo-mineral nutrition is much better even compared with a mineral background that formed the indicators of quality of soriz grain: it increases the content of protein, starch, total sugars, weight of 1000 grains and the like. At the same time, as determined by us, in the aftereffect, the yield of subsequent crops, which were placed after the cut in all parts of the crop rotation, for the joint use of straw and mineral fertilizers was higher as compared to the control and background of nitrogen-phosphorus fertilizer.

Therefore, the basis of any system of crop production is crop rotation. It is the leading part of the zonal system of agriculture and effective agroecological factor. At the same time, in modern technologies of growing crops, the role of the predecessor is decisive, since elements of the technology of growing the next crop depend on it. Proper crop rotation allows the use of a rational system of fertilizer and soil treatment on the basis of which during rotation to maintain optimal water and nutrient regimes for plants to successfully clear the fields from weeds, pests and diseases, is much more efficient to store and use the moisture, fertilizers and thus improve soil fertility for minor expenses while using performance. We show this by the example of growing winter crops on different predecessors (Fig. 1). These data illustrate the advantages of black steam compared to corn and stubble predecessor.

When applying mineral fertilizers on the natural backgrounds of predecessors in the recommended doses for the Steppe zone of Ukraine, grain yield increases significantly, and more significantly for non-steam more depleted predecessors. Of course, for obtaining the highest levels of grain yield, it is much more effective in this field to use the reserves of accumulated soil moisture and precipitation of the growing season, which is extremely important for the arid zone of the southern Steppe of Ukraine. For the cultivation of crops in modern conditions of management and certain

climate changes, the limiting factor in the formation of their high productivity is the provision of plants with moisture [8].



Notes: 1 – winter wheat (2008-2006 and 2015);
2 – barley (2014-2016);
3 – triticale (2014-2016);
4 – rye (2014-2016);
5 – average for all grains

Figure 1. The yield of winter crops depending on the predecessor and feed background

Technological methods of growing crops should be directed to the maximum possible accumulation of moisture in the soil and its use by plants for the formation of the crop. The accumulated moisture in the soil for the period of sowing of any crop and precipitation of the vegetation period are used much more productively on fertile soils, for the introduction of organic and mineral fertilizers, that is, for the optimization of plant nutrition.

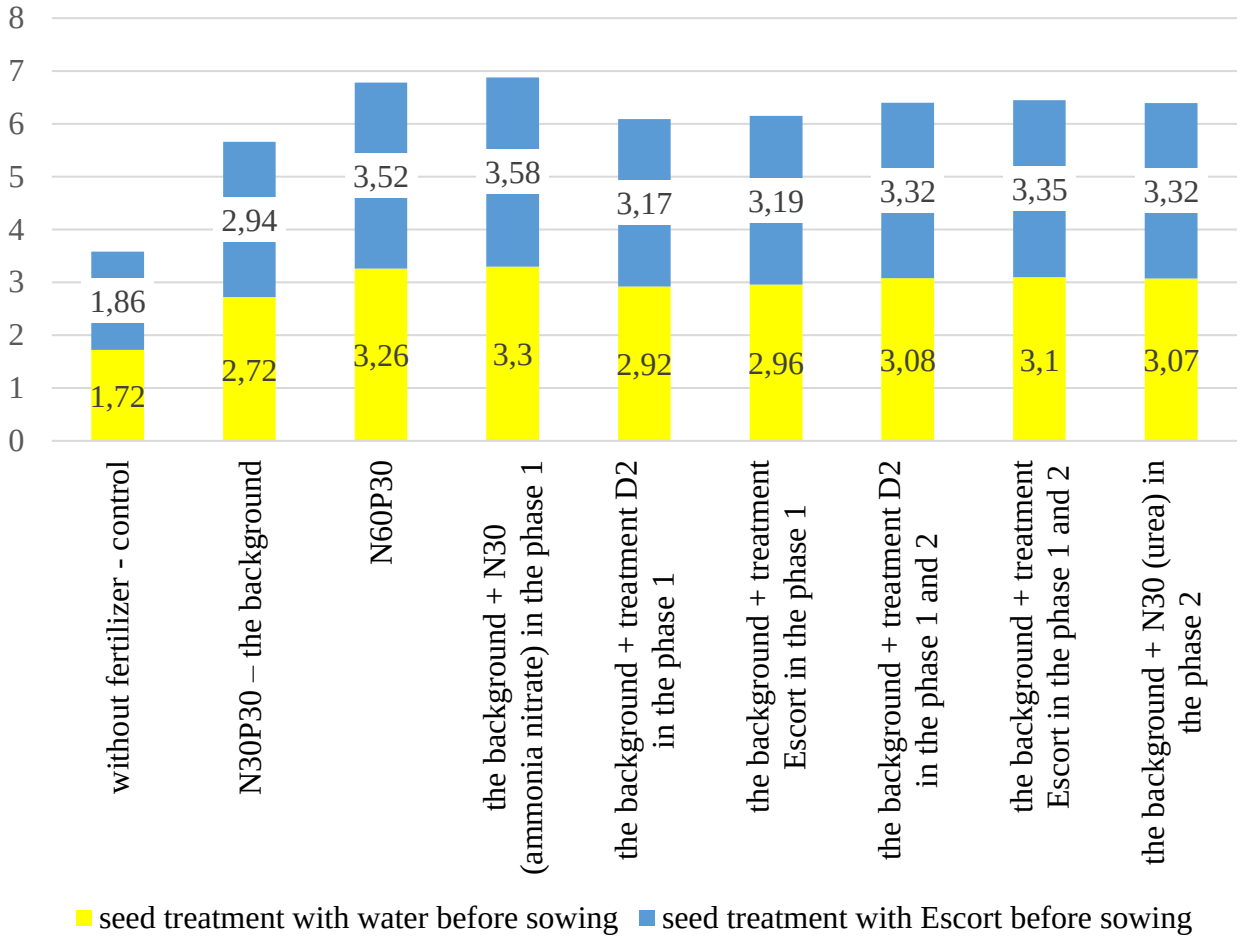
On depleted soils, among the limiting factors, the second place after moisture is taken by the provision of plants with accessible nutrients and, above all, nitrogen. However, as a result of insufficient amount of fertilizers (especially organic ones) and deterioration of soil fertility there is a need to develop new approaches to their nutrition [9,10].

One of the ways of optimizing plant nutrition for these conditions should become more widely applied to the background of moderate doses of mineral fertilizers,

modern growth-regulating substances for the treatment of seeds before sowing and planting of plants at key periods of the growing season. We have conducted research in this direction and continue to perform it on a number of crops: barley, wheat, triticale, red, soybean, peas, chickpeas, sunflower and other spring and winter crops. The effectiveness of this approach to nutrition optimization is shown by the example of spring wheat (Fig. 2).

These data convince of a significant increase in grain yield in comparison with inconvenient control. Moreover, from application to sowing of N_{30} P_{30} it increased on average over the three years from 1.72 to 2.72 g/ha. Maximum yield values are reached for nitrogen fertilization on the background of N60 P30 just in time for planting (3.26 t/ha) and N30 P30 before sowing + N_{30} at the feeding in the early exit of plants in the tube (3.30 t/ha). Almost at the same level, it was formed by double treatment of plants with D2 (3.08 t/ha) and escort (3.10 t/ha).

With presowing treatment of seeds with an escort, the grain yield was formed even higher, which is convincingly illustrated by Fig. 2.



Notes: phase 1 - exit of plants in up;
phase 2-the beginning of earing

Figure 2 Grain yield of spring wheat depending on the background of the supply and use of regulating substances t/ha (average for 2014-2016)

Studies with growth-regulating drugs were conducted in 2016-2017 with two varieties of spring barley – Stalker and Vakula. In addition to D_2M and Escort bio, fresh florid was used to optimize nutrition in doses of 200 and 300 g / ha and Fresh energy (200 g/ha), which are recommended for spring barley. On average, over the years of research Stalker provided in the control of 2.78 t/ha, Vakula – 2.77 t/ha of grain, with the use of all studied biopreparations on average for all 15 options, the yield increased to 3.59 t/ha and 3.57 t / ha or increased to control without fertilizers by 29.1 and 28.9%, respectively. However, it should be noted that in 2016, the higher grain yield was formed by the Vakula – 4.31 t/ha (the weighted average for all variants of the experience), and in the arid 2017 – only 2.73 t/ha (Table 4). That is, the sort of spring barley Stalker is more plastic and is able to form a stable performance with less dependence on weather and climatic conditions of the year.

Similar results were obtained in the treatment of seeds and plants with bio substances in the cultivation of two varieties of peas Oplot and Tsarevich, the yield of which for three years from these substances increased by an average of 28-30%. At the same time, as in the cultivation of spring crops, the main indicators of the quality of pea grain are significantly improved, the number and mass of nodule nitrogen-fixing bacteria on the roots of plants increases, moisture is effectively used, the cost recovery for the introduced resource-saving measures in the cultivation of this legume crop increases. Similar results were obtained on two varieties of chickpea-Rosanna and Memory.

The same data on the optimization of nutrition through the use of bio substances were obtained for the cultivation of sunflower (grade Dragan). Also in studies conducted in 2016-2017 without fertilizers formed 2.45 t/ha, on the background of the application $N_{15}P_{15}K_{15}$ (100 kg/ha of NPK) – to 2.94 t/ha, and in the processing plants in the phase of 8-10 leaves and education of the basket, depending on the selection Restigouche substances from of 3.02 to 3.48 t/ha. Under the influence of this measure increases the mass of 1000 seeds, test weight, fat content in grain and the conditional yield of oil per unit area, and alcalinity, on the contrary, decreases.

Thus, as it is known and confirmed by our studies with many crops, to increase their productivity and main indicators of the quality is possible by the application on the background of moderate doses of fertilizers and modern growth-regulating substances. This measure provides nutrition of young plants with macro-, microelements and partially organic matter (humins) through leaves. The assimilation of all nutrients with this approach increases significantly, which in turn contributes to the development of plant specific substances and proteins that increase their resistance to disease, drought, high temperatures and the like.

Table 4 Grain yield of spring barley varieties depending on resource-saving optimization of nutrition, t/ha

Variant	Number of treatments	Varieties (factor B)									
		Stalker					Vakula				
		years of research			the increase in yield		years of research			the increase in yield	
		2016	2017	average	t/ha	%	2016	2017	average	t/ha	%
Control		2.91	2.64	2.78	0	0	3.26	2.27	2.77	0	0
1. Fresh Floride 200 g/ha	1 treatment	3.67	2.75	3.21	0.43	15.5	4.07	2.43	3.25	0.48	17.3
	2 treatments	3.92	3.08	3.5	0.72	25.9	4.38	2.92	3.65	0.88	31.8
	3 treatments	4.04	3.34	3.69	0.91	32.7	4.52	3.24	3.88	1.11	40.1
1. Fresh Floride 300 g/ha	1 treatment	3.92	3.32	3.62	0.84	30.2	4.32	2.74	3.53	0.76	27.4
	2 treatments	4.28	3.7	3.99	1.21	43.5	4.75	3.02	3.89	1.12	40.4
	3 treatments	4.54	3.93	4.24	1.46	52.5	5.07	3.39	4.23	1.46	52.7
1. Fresh Floride 200 g/ha	1 treatment	3.69	2.74	3.22	0.44	15.8	4.13	2.29	3.21	0.44	15.9
	2 treatments	3.9	3.09	3.5	0.72	25.9	4.33	2.45	3.39	0.62	22.4
	3 treatments	3.97	3.37	3.67	0.89	32	4.45	2.59	3.52	0.75	27.1
1. D_2M_1 1000 g/ha	1 treatment	3.46	2.97	3.22	0.44	15.8	3.87	2.31	3.09	0.32	11.6
	2 treatments	3.84	3.3	3.57	0.79	28.4	4.31	2.85	3.58	0.81	29.2
	3 treatments	4.28	3.84	4.06	1.28	46	4.8	3.06	3.93	1.16	41.9
1. Escort 250 g/ha	1 treatment	3.48	2.7	3.09	0.31	11.2	3.86	2.36	3.11	0.34	12.3
	2 treatments	3.82	3.03	3.43	0.65	23.4	4.25	2.75	3.5	0.73	26.4
	3 treatments	4.15	3.39	3.77	0.99	35.6	4.65	3.05	3.85	1.08	39.0

In addition, nutrients, which are components of the growth-regulating substances, after contact with the leaf surface of the plants are rapidly absorbed, they pass the same way of synthesis as the elements that enter the plant through its root system, but 5 or more times faster. During seed treatment, biostimulators enhance the growth and

development of seedlings, in the subsequent phases of vegetation increase the intensity of photosynthetic activity of plants, in general, positively affect the yield and quality of grown products. Moreover, due to higher levels of crop yields due to use for power optimization growth-regulating substances, after the end of the growing season in the soil and remains much more plaintive-root residues, which in turn serve as organic fertilizer for the next crop. Thus, growth-regulating substances have a positive impact on the preservation of the main indicators of soil fertility.

For the southern Steppe zone of Ukraine, the presence of organic matter in the soil is extremely important for the accumulation, retention and further economical consumption of moisture by plants for crop formation. In compacted and depleted organic matter soil differences water in the rain and especially for high temperature conditions practically do not wet the soil, and evaporates quickly, that is, moisture is lost unproductively. The specified negative sign is not shown on fertile soils at high culture of agriculture. Consequently, even after prolonged drought, the moisture in these soils is retained and better used by plants. The importance of organic farming in this case increases, because in the South of Ukraine the main limiting factors for obtaining high yields of crops is the presence of moisture.

Our studies have determined that organic fertilizers in their properties can significantly improve the water-absorbing and water-retaining capacity of the soil, they act as mulch for the top layer of the soil, prevent evaporation of moisture and its unproductive losses. We show the above on the example of the influence of different types of organic fertilizers on the water-clay ability of the soil (Table 5).

Table 5 Water-absorbing ability of soil under the influence of organic fertilizers (average for three years)

Experiment variant	Water absorbed, mm/h	% before control
Without fertilizer	11,69	100,0
Manure 30 t / ha	13,60	116,0
Green manure (peas)	15,30	130,9
Green fertilizer (rapeseed)	14,73	126,0

Much more effectively moisture is used to optimize nutrition, which can be traced at the example of sunflower, which was grown without the introduction of organic and mineral fertilizers, and during the growing season only foliar feeding growth regulating substances were used.

For the conditions of the southern Steppe of Ukraine, which is characterized as a zone of unstable moisture and risky agriculture, when in some periods in the region for 100-120 days there is no precipitation, it is important to use moisture with the greatest efficiency – its reserves in the soil during the sowing of crops and precipitation that fell

during its growing season. We have determined the total water consumption of sunflower plants in the years of cultivation, its data are shown in table 6.

Table 6 Total water consumption of sunflower and its balance in the years of cultivation

Years of research	Components of water consumption, m3 / ha			Share of total water consumption, %	
	Soil moisture	Precipitation of the vegetation period	General water consumption	Soil moisture	Precipitation of the vegetation period
2016	980	2293	3273	29.9	70.1
2017	670	1636	2306	29.1	70.9
The average for 2016-2017	825	1965	2790	29.6	70.4

Significantly higher total water consumption was determined in a more favorable moist year – 2016, in which the soil moisture reserves were also large. However, in both years growing in the balance of total water consumption, the proportion of both soil moisture and precipitation of the growing season were almost the same. At the same time, it is most important to determine the coefficient of water consumption that characterizes the amount of moisture that the plant spends on the formation of the crop unit.

Sunflower crops on average for two years of research the least effectively used moisture without the use of biological products for foliar feeding. Thus, during treatment of crops with water only (control) plants spent 1320,4 m^3/t, slightly less than the coefficient of water consumption already in processing plants in the phase of 3-4 pairs of leaves with retardin (0.25 kg/ha) 1211,9 m^3/t. with Fresh energy depending on the doses of use – 1005.11-1171.6 m^3/t, and these two drugs together: 941.7 is 1128 m^3/t.

Carrying out fertilizing in the budding phase provided a more efficient use of moisture by sunflower plants. Among two feedings in the phase of 3-4 pairs of leaves budding and the coefficient of water consumption was reduced to 873.4-912.3 m^3/t. Therefore only due to the processing of sunflower crops with growth regulators according to the background gopong application of mineral fertilizers $N_{16}P_{16}K_{16}$ it is possible to reduce the ratio of water consumption to 9.0-51.2 %.

It should be noted that since two years of sunflower cultivation, the water consumption coefficient has been determined somewhat higher in 2016, and in 2017, it was slightly less favorable in terms of precipitation.

The importance of biological products in improving the efficiency of water consumption of sunflower is illustrated in Fig. 3, where the better time for foliar application is clearly seen.

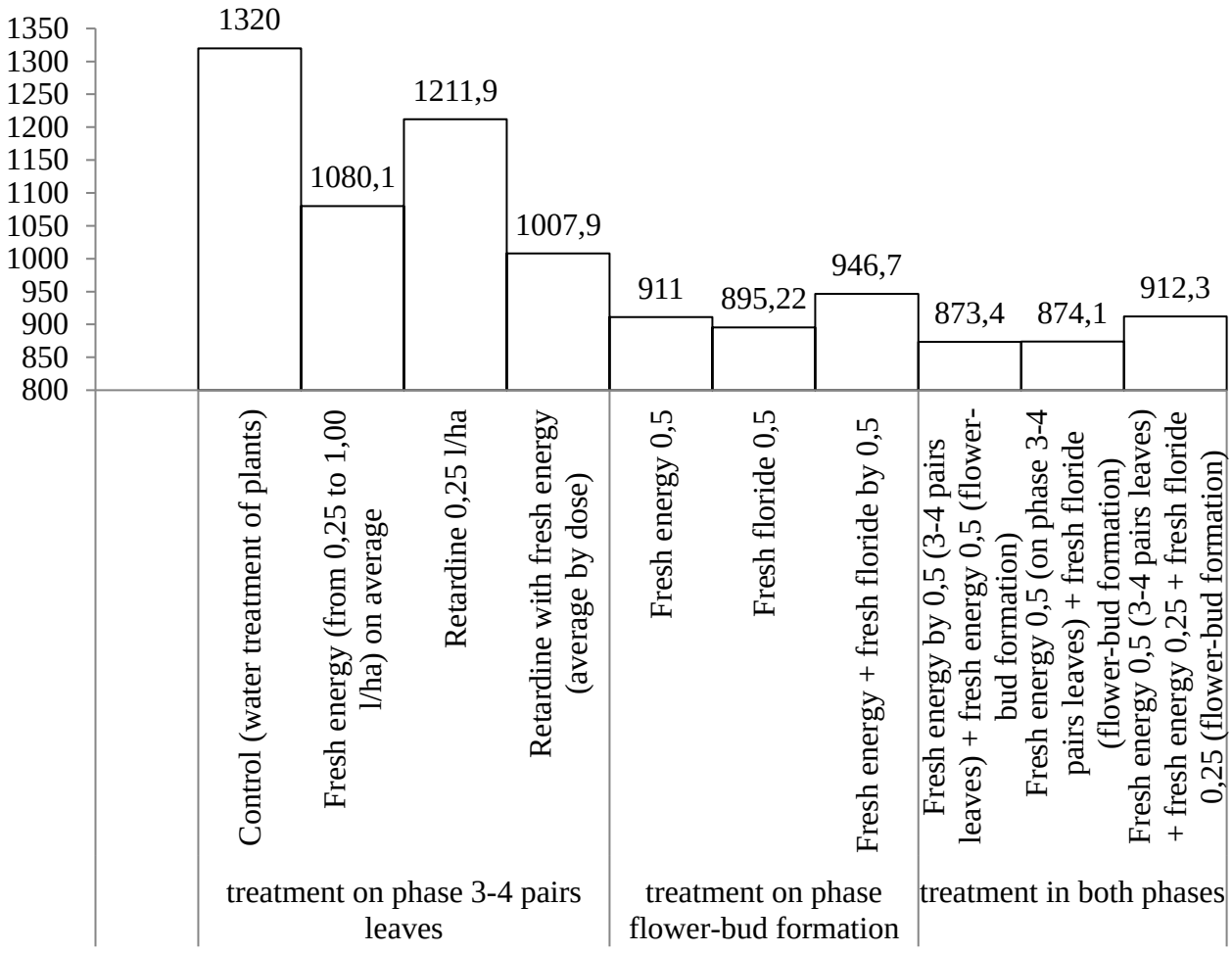


Figure 3. Influence of doses and timing of fertilizing with biopreparations on the coefficient of water consumption of sunflower (average for 2016-2017), m^3/t

Treatment of plants with bio substances during budding is much more appropriate in comparison with the phase of formation of 3-4 pairs of leaves. Feeding in the budding phase according to the values of the water consumption coefficient slightly differs from their values in the processing of sowing twice in both phases of the development of sunflower plants.

CONCLUSION

Thus, as it is determined by the results of our research, the level of crop yields is significantly determined by the degree of soil fertility, namely it depends on its supply with the organic matter and the content of basic nutrients. It grows under the influence of fertilizers, the use of which on poorer soils contributes to a more significant increase in yield compared to fertile ones. A prominent place should be given to scientifically based alternation of crops in crop rotation, which improves the basic indicators of soil fertility, enriching it with organic matter and reduces the cost of production.

Due to the increase in organic matter in the soil, water absorption capacity and efficiency of moisture use by plants significantly increases. In the conditions of modern resource provision of the agricultural sector, in particular the high cost of mineral fertilizers, the missing volumes of organic application should be developed and modern approaches to plant nutrition should be implemented. The most effective and cheapest method is the use of biologics and growth regulating substances for presowing treatment of seeds or planting plants in the main periods of the growing season. This allows to reduce the dose of mineral fertilizers, increase crop yields, increase their resistance to drought and adverse environmental conditions, has a positive effect on the main indicators of quality of grown products, elements of fertility and significantly improves the efficiency of the use of plants moisture on the formation of the crop unit.

With such resource-saving approaches it is possible to achieve a certain stability in the management of agricultural crops, including in the zone of unstable moisture when changing soil and climatic conditions of the southern Steppe of Ukraine, which is the breadbasket, the source of vegetables, melons and other crops.

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