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ENERGY EFFICIENCY OF SUGAR BEET GROWING ACCORDING TO DIFFERENT FARMING SYSTEMS IN THE RIGHT-BANK FOREST-STEPPE OF UKRAINE

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The results of research on the impact of different farming systems on yield and energy efficiency of sugar beet growing in Right-bank Forest-steppe of Ukraine. Found that the ecological farming system involving periodical mouldboard basic soil tillage in crop rotation is the most energy effective which provides a significant increase on the 10% of Kee criterion to 7.7 compared with the control.

Productivity, energy efficiency, farming system, sugar beets.

The world increasingly face the problem of renewable energy sources. In this regard, topical preparation and use of energy accumulated by plants because of their photosynthetic activity. Technologies for energy production from biomass plants are at the beginning of its development in Ukraine, but have a powerful potential and prospects [9].

In the current economic conditions, increasing importance is the question of reducing the upper conduction and rational use of resources in technologies of growing crops, particularly energy intensive, particularly sugar beet. Before that encourages relatively high prices for basic logistical energy used in growing technologies of field crops (fuel and lubricating materials, fertilizers, pesticides, agricultural machinery and spare parts) [1].

In a dynamic market economy is not always possible to give an objective assessment of the effectiveness of the chosen system of growing crops in value.

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Energy indicators are in a lesser dependent on the market economy, so adequate assessment of farming systems and methods of basic soil tillage important to determine their energy efficiency [3, 4, 5, 6].

Modern energy evaluation method based on the comparison of energy accumulated in the yield, with total costs of production per unit area [8].

The measure serves the energy efficiency of the energy efficiency ratio (Kee), which represents the ratio of the total energy content in locally grown products (Ep) to the amount of non-renewable energy (En) spent on its cultivation. To assess the energy efficiency of technological measures or entire farming systems also use the difference between the accumulated value of products grown with total non-renewable energy and energy spent on its cultivation, known as the coefficient of expediency energy [3, 4, 8].

The purpose of the research is to establish patterns of variation of the energy efficiency of sugar beet growing in different farming systems in the Right-Bank Forest-Steppe of Ukraine.

Materials and methods of research. Experimental researches were in a stationary experiment of the department of agriculture and herbology on "Agronomic Research Station" of NULES of Ukraine (Pshenychne, Kyiv region) during 2012–2013.

Soil cover research areas typical black soil humus. The humus content in the plow layer soil is 4%, pH - 6.8, absorption capacity is 32,5 mh-ekv/100 g soil. Groundwater located at a depth of 5-6 m.

Scheme of crop rotation is typical for forest-steppe conditions: lucerne – winter wheat – sugar beet – corn for silage – winter wheat – maize – pea – winter wheat – sugar-beet – barley with sowing of lucerne.

The object of research is the field of sugar beets in the link with peas.

Variants of the stationary experiment are located by split plots method. Repeated of experiment – are four times, accommodation variants in repetition –

regular. Plots of first order with variants of soil tillage had 280 m², accounting – 225 m². The plots of the second order applied system of fertilization and plant protection. Plots area was 93.6 m², accounting - 75 m².

Graduation of the first factor (A) is system of agriculture. They are composed based on their resource supply for the reproduction of soil fertility:

Industrial (control) is the priority use of industrial agrochemicals for the reproduction of fertility of soil, bringing on a 1 hectare of area of crop rotation of 24 t organic fertilizers, 300 kg of NPK of mineral fertilizers and intensive application of pesticides for protecting of sowing from harmful organisms;

Ecological is the priority use for the reproduction of soil fertility of organic fertilizers. Bringing on a 1 hectare of area of crop rotation of 24 t organic fertilizer (12 t leave to rot, 6 t of not commodity part of harvest, 6 t mass of green manure), and 150 kg of NPK of mineral fertilizers. In addition, complex biological seed treatment, by application of chemical preparations after the criterion of ecological and economical threshold of presence of harmful organisms;

Biological – application only of natural resources is 24 t/ha organic fertilizers for the reproduction of soil fertility without bringing of industrial agrochemicals, use of complex bio preparation for treatment of seed and biological facilities of defence of sowing.

The system of soil tillage in crop rotation in each model of agriculture presented in four variants: differentiated (control) with the execution six different deep ploughings during rotation, two disking on 8–10 cm under winter wheat after peas and silage corn and one land clearer cultivation during barley; subsurface ploughing – different deep subsurface plough soil loosening under all crops except the surface tillage under winter wheat in the fields listed in the control; periodical mouldboard tillage: includes ploughing under sugar beet, surface cultivation under winter wheat in the fields listed in the control and subsurface ploughing under other crops; superficial: disking to a depth of 8–10 cm for all crops.

Statistical analysis of the data was determined by the method described by B. A. Dospehov [2].

The results of the research. Sugar beet is a recognized champion biological productivity of crops temperate zone of the planet. Only they can under favourable conditions to synthesize up to 28 t / ha of dry matter during the growing season and they accumulate the maximum energy of sunlight in the form of carbohydrates - sugars [7].

The data convincing evidence that significantly highest yield obtained by culture studied industrial farming system (74 t/ha) (fig. 1). Application of ecological system though significantly lower than the control, but there is a tendency to approach the level of productivity to the control (68,6 t/ha). Significantly lower yield of roots by 36,8% (47 t/ha) in controlling the deterioration reasoned phytosanitary and nutrient regimes in areas of biological farming systems for the complete abandonment of chemical protection compared with its industrial and environmental model.

Among soil tillage the best results were obtained by periodical mouldboard tillage – 69,4 t/ha, with a significant difference. For superficial main cultivation of root crops yields were lower. Thus, subsurface ploughing loosening significant decrease in yield of sugar beet by 10,3 %, while the surface – 18,7 % of the control.

Interaction factors found the best indicator of productivity by combining industrial farming systems with periodical mouldboard tillage, thereby increasing productivity culture by 6.9 % with respect to control, to 83,3 t/ha. For ecological farming system in conjunction with periodical mouldboard tillage were 74,7 t/ha, which is closest to the result of control. The negative effect of a combination of biological farming systems with surface and subsurface ploughing basic soil provided a significant reduction of yield by 48,5 and 44,2 % compared with the control.

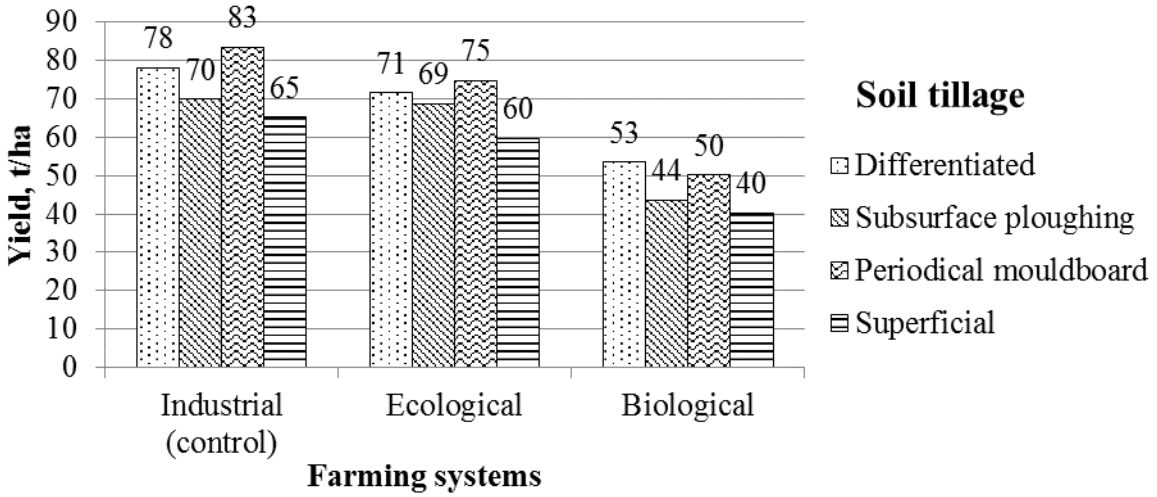

Fig. 1. Sugar beet yield depending on the farming system and basic soil tillage (average for 2012-2014)

Note: LSD_{05} A – 3,48 t/ha, LSD_{05} B – 4,02 t/ha, LSD_{05} AB – 4,11 t/ha.

The analysis of the energy balance of sugar beet cultivation showed that the most efficient energy production occurred at ecological farming system energy efficiency ratio stood at 7.0, which is 13% dominated control (fig. 2). Thus, somewhat lower yield for ecological agriculture offset significantly lower cost non-renewable energy compared to controls.

Among the basic soil tillage effectively used for energy of periodical mouldboard is while Kee - 7.0, due primarily to a greater yield crops and reduced fixed costs soil tillage, the main means of production and fuel.

Subsurface ploughing and surface cultivation Kee - 6,1 and 5,7 significantly inferior control. The greatest energy efficiency of sugar beet growing was achieved in the variant of ecological farming systems in combination with periodical mouldboard, Kee – 7,7 (fig. 2).

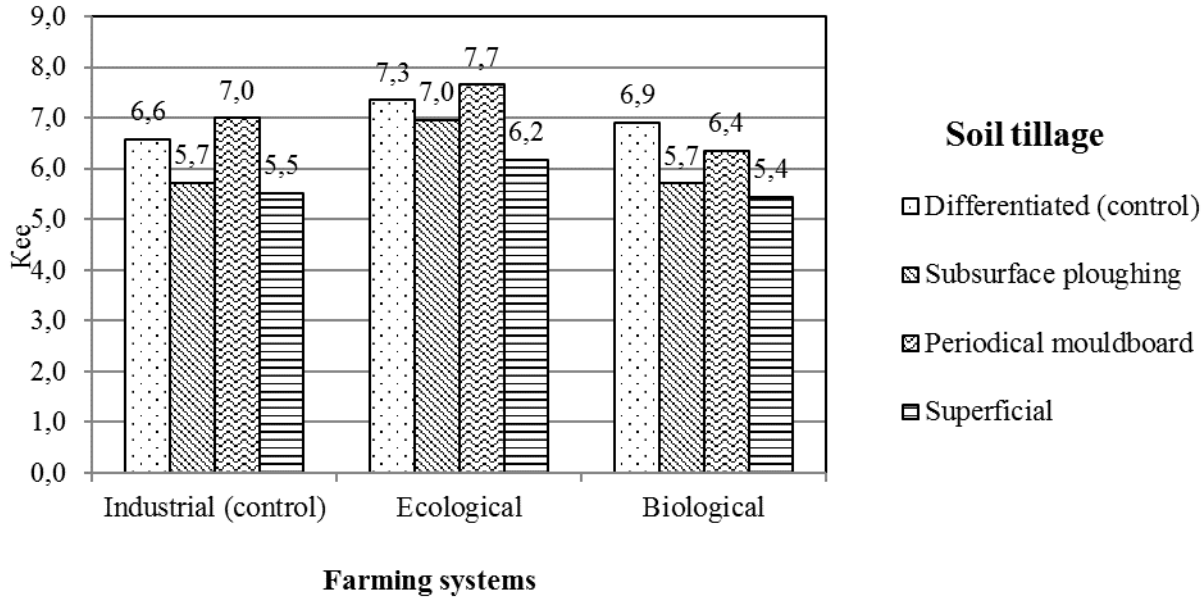

Fig. 2. Energy efficiency coefficient of sugar beet growing in different farming systems and basic soil tillage (average for 2012-2014)

Note: LSD_{05} A – 0,21, LSD_{05} B – 0,25, LSD_{05} AB – 0,43.

Conclusions. In conditions in Right-bank Forest-steppe of Ukraine on sugar beet growing systems of the investigated farming systems and primary soil tillage in crop rotation proved highly effective.

For energy efficiency ecological farming system combined with periodical mouldboard soil tillage in crop rotation provides sugar beet growing with Kee - 7.7, 10% significantly dominating control (industrial farming systems).

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Приведены результаты исследований влияния различных систем земледелия на урожайность и энергетическую эффективность выращивания сахарной свеклы в Правобережной Лесостепи Украины. Установлено, что наиболее энергетически эффективная экологическая система земледелия в комплексе с отвально-безотвальной обработкой почвы, что обеспечивает повышение Кее до 7,7, что больше на 10% по сравнению с контролем.

Урожайность, энергетическая эффективность, система земледелия, сахарная свекла.

Викладені результати досліджень щодо впливу різних систем землеробства на урожайність та енергетичну ефективність вирощування

буряків цукрових у Правобережному Лісостепу України. Встановлено, що найбільш енергетично ефективною є екологічна система землеробства з участю полицево-безполицевого обробітку ґрунту в сівозміні, що забезпечує істотне на 10 % підвищення критерію $К_{ее}$ до 7,7 порівняно з контролем.

Урожайність, енергетична ефективність, система землеробства, буряки цукрові.