AGROCHEMICAL AND ECONOMIC ASSESSMENT OF ALTERNATIVE SYSTEMS OF SUGAR BEET FERTILIZATION IN WESTERN FOREST STEPPE

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There has been shown the influence of "biologization" of fertilization systems on the balance of humus and nutrients and crop producing capacity of sugar beet. There has been ascertained the economic efficiency of combined use of straw and green manure on the background of mineral fertilizers.

Key words: *fertilization, straw, green manure, manure, balance of humus, balance of nutrients, crop producing capacity of sugar beet.*

The transition of agroindustrial sector to the principles of market economy resulted in drastic changes in specialization of the majority of agricultural enterprises, namely the dramatic decrease in cattle stock and consequently the decrease in manure production

To secure steady and sustainable development of crop farming in modern conditions it is required to elaborate and implement alternative systems of fertilization differentiated according to the rates of mineral fertilizers, sources of organic substances and capital intensity.

First of all it is important to know the ways to provide deficit-free balance of humus, macro- and microelements in crop rotation and thus to preserve and reproduce potential fertility of soils. [4].

The widely spread method of increasing the supply of fresh organic substances is application of plant by-products and cultivation of green manure with the purpose of fertilization. [1,2,5,6].

In the conditions of Western forest steppe sugar beet is one of the most fertilizer exigent plants. The cost of sugar beet fertilization can reach 35-50% of the total cost of cultivation. That is why the objective of the research was the elaboration of the optimal system of sugar beet fertilization based on the soil, ecological, agronomical and economic assessment of all its components: mineral fertilizers, manure, plant by-products and green manure.

Methods of research. Field research was carried out in the fields of stationary experiment of Institute of Agriculture of Western Polissya, which is situated in the village of Shubkiv, Rivne district, Rivne region.

The soil of experimental plot is dark-grey podzolized light loamy. The sown area is 90 m^2, the area of record plot is 50 m^2. The triple repeatability, the systematic disposition of plots. Within the frames of the experiment there was sown sugar beet hybrid – Shevchenkivstyy. The predecessor of sugar beet in crop rotation was winter wheat after which there was sown runchweed and there was applied straw together with a compensational dose of nitrogen according to the scheme of the experiment. The techniques of crops cultivation corresponded to those recommended for the area of Western forest steppe.

Mineral fertilizers were introduced in the form of ammonium nitrate, ordinary superphosphate and potassium-magnesium: phosphorous and potash fertilizers were applied during under-winter ploughing, nitrogen fertilizers were applied during spring cultivation.

The sugar content in beet roots was defined according to the polarimetric method. Recording of the crop was carried out by means of gathering and weighing of produce from all the record area of each plot.

Statistic processing of data was carried out by the method of dispersion analysis according to B.A.Dospekhov [3].

Results of the research. Humus is the main source of nutrients and and energy material for the majority of soil microorganisms. It slows down the processes of wash-out of nutrients from the root containing layer, increases the efficiency of mineral fertilizers and thermal conditions of soil. In order to maintain

the required balance of humus it is necessary to apply organic fertilizers. According to the results of research the most efficient organic fertilizer which provides the biggest accumulation of humus, is manure. The best balance of humus is as follows: 1,62 t/ha was provided by the application of 40 t/ha of manure, and together with the mineral fertilizers - 1,60 t/ha (table 1).

The balance of humus without fertilizers and based on the mineral system of fertilization was negative and 0,68 and 0,59 t/ha respectively. The application of green manure on the background of mineral fertilization did not secure the positive balance of humus, 0,69 t/ha being applied the balance constituted 0,24 t/ha.

Among alternative sources of organic substances the most significant role in provision of humus is played by straw. Thus, the use of straw in combination with green manure on the background of mineral nutrition provided the positive balance of humus, which constituted 0,53-0,82 t/ha.

1. The balance of humus in growing sugar beet according to different systems of fertilization, t/ha

Variant	Supply, total	Including:		Losses	Balance, +-
		humification of nutrient root residues	humification of organic fertilizers		
Without fertilizers (control)	0,25	0,25	-	0,93	-0,68
$N_{120}P_{120}K_{120}$	0,33	0,33	-	0,93	-0,59
40 t/ha of manure	2,55	0,39	2,16	0,93	1,62
$N_{120}P_{120}K_{120}$ + 40 t/ha of manure	2,53	0,37	2,16	0,93	1,60
$N_{120}P_{120}K_{120}$ + green manure	0,69	0,42	0,27	0,93	-0,24
$N_{120}P_{120}K_{120}$ + straw	1,46	0,32	1,13	0,93	0,53
$N_{120}P_{120}K_{120}$+ straw and green manure	1,74	0,34	1,40	0,93	0,82

The use of such alternative sources of organic substances as green manure and straw on the background of mineral fertilizers in comparison with control

(without fertilizers) provided the increase in the balance of nitrogen by 7,5-71,8 kg/ha, however, it remained negative -81,4 kg/ha up to -17,1 kg/ha (Table 2). The biggest intensity of the balance of nitrogen from the alternative sources of fertilization (92,9%) was provided by the application of straw on the background of mineral fertilizers.

The traditional organic and mineral system of fertilization using 40 t/ha of manure on the background of mineral fertilizers ensured the positive balance of nitrogen – 49,1 kg/ha with the intensity of 117,0%.

2. The balance of nutrients humus in growing sugar beet according to different systems of fertilization, kg/ha

Item of balance	Variant of research						
	1	2	3	4	5	6	7
Nitrogen							
Supply	17,1	137,1	217,1	337,1	137,1	222,9	222,9
Losses	106,0	179,5	217,0	288,0	218,5	240,0	248,0
Balance, +-	-88,9	-42,4	0,1	49,1	-81,4	-17,1	-25,1
Intensity of balance, %	16,1	76,4	100,0	117,0	62,7	92,9	89,9
Phosphorous							
Supply	-	120,0	100,0	220,0	120,0	132,9	132,9
Losses	25,0	39,4	46,0	59,8	49,5	52,8	54,9
Balance, +-	-24,9	80,6	54,0	160,2	70,5	80,2	78,1
Intensity of balance, %	0,1	304,7	217,4	367,9	242,3	251,9	242,3
Potassium							
Supply	4,6	124,6	244,6	364,6	124,6	165,9	165,9
Losses	118,7	185,3	215,9	279,5	232,1	247,1	256,7
Balance, +-	-114,1	-60,7	28,7	85,1	-107,5	-81,3	-90,9
Intensity of balance, %	3,9	67,2	113,3	130,4	53,7	67,1	64,6

Thanks to low losses and high supply all the systems of fertilization ensured the positive balance of phosphorous. Its negative balance (-24,9 kg/ha) was recorded only in the control plot (without fertilizers). The use of straw and green manure with the purpose of fertilization on the background of mineral fertilizers ensured the balance of phosphorous within 70,5-80,2 kg/ha, while within the mineral system of fertilization it constituted 80,6 kg/ha.

The highest balance of phosphorous (174 kg/ha) was ensured as a result of application of 40 t/ha of manure. The losses within this system of fertilization

constituted only 46,0 kg/ha, the intensity of balance was 478,1%. The application of manure, both separately and in combination with mineral fertilizers ensured the positive balance of potassium which constituted 28,7 i 85,1 kg/ha respectively. The organic – mineral system of fertilization with the use of straw and green manure on the background of mineral fertilizers ensured the negative balance of potassium from -81,3 up to -107,5 kg/ha, and within the mineral system of fertilization - 60,7 kg/ha. It is explained by the high wash-out of potassium together with the crop of sugar beet and losses, which constituted 232,1 – 256,7 kg/ha in the case of application of straw and green manure on the background of mineral fertilizers, and in the mineral system of fertilization - 185,3 kg/ha.

The crop producing capacity of crops remains one of the main indices of productivity. The results of research on the influence of different systems of fertilization on the crop producing capacity of sugar beet show that the biggest producing capacity of the above crop was recorded when the organic – mineral system of fertilization was applied. The increase in comparison with the control plot without fertilizers constituted from 18,8 up to 26,8 t/ha (Table 3).

3. Producing capacity and quality of sugar beet depending on different systems of fertilization, mean value from 2007 to 2010.

Variant of experiment	Crop producing capacity, t/ha	Deviations, ±		Sugar content, %	Sugar accumulation, t/ha
		From control	From the mineral system of fertilization		
Without fertilizers (control)	19,2	-	-	16,8	3,2
$N_{120}P_{120}K_{120}$	30,3	11,1	-	16,5	5,0
40 t/ha of manure	35,4	16,2	-	16,5	5,8
$N_{120}P_{120}K_{120}$ + 40 t/ha of manure	46,0	26,8	15,7	16,8	7,7
$N_{120}P_{120}K_{120}$ + green manure	38,1	18,8	7,7	16,4	6,2
$N_{120}P_{120}K_{120}$ + straw	40,6	21,4	10,3	16,7	6,8
$N_{120}P_{120}K_{120}$+ straw and green manure	42,2	23,0	11,9	16,8	7,1
HIP_{05}, t/ha	1,2-1,6				

The combination of straw and green manure provided the increase in the crops of sugar beet by 11,9 t/ha. Within the mineral system of fertilization ($N_{120}P_{120}K_{120}$) gathering of sugar beet from 1 hectare constituted 30,3 t, which is 11,1 t more compared with the control (without fertilizers).

According to the traditional organic – mineral system of fertilization $N_{120}P_{120}K_{120}$ + 40 t/ha of manure the crop producing capacity of sugar beet was the highest and constituted 46,0 t/ha, the increase up to the control - 26,8 t/ha.

While substituting manure by straw in combination with green manure on the background of mineral fertilization the crop producing capacity increased up to – 42,2 t/ha.

The application of green manure only on the background of $N_{120}P_{120}K_{120}$ ensured the crop producing capacity of sugar beet – 38,1 t/ha. The substitution of green manure by straw on the background of $N_{120}P_{120}K_{120}$ contributed to the increase in crop producing capacity by 2,6 t/га.

The use of different systems of fertilization influenced significantly the quality of sugar beet. The biggest sugar content in roots (16,8%) was recorded in two organic-mineral systems of fertilization: $N_{120}P_{120}K_{120}$ + 40 t/ha of manure and combination of straw and green manure on the background of NPK. Sugar accumulation in both variants constituted 7,7 і 7,1 т/га.

The mineral system of fertilization with application of $N_{120}P_{120}K_{120}$ and the organic one with application of 40 t/ha of manure provided the equal content of sugar in roots – 16,5%, and the accumulation of sugar 5,0 andi 5,8 t/ha respectively.

The organic-mineral system of fertilization with application of $N_{120}P_{120}K_{120}$ together with manure ensured the collection of sugar 6,2 t/ha, its content being 16,4%.

In general all the mineral – organic systems of fertilization contributed to the collection of sugar from 6,2 to 7,7 t/ha, which is 3,0-4,5 t/ha more compared to the control and 1,2-2,7 t/ha more than in the mineral system of fertilization ($N_{120}P_{120}K_{120}$).

While analyzing the indices of economic efficiency one can make a conclusion that the most costly is the traditional organic-mineral system of fertilization - $N_{120}P_{120}K_{120}$ + 40 t/ha manure. While growing sugar beet according to the above system of fertilization the expenses constitute 13433 UAH per hectare, while in the control variant (without fertilizers) - 3476 UAH per hectare, the expenses for fertilization - 9957 UAH per hectare or 74,1% of total (Table 4). Because of big expenses and low conventionally net profit (2667 UAH per hectare) the level of profitability of this variant was the lowest - 19,9 %.

4. Economic efficiency of sugar beet cultivation depending on different systems of fertilization, mean value from 2007 to 2010

Variant of experiment	Total expenses per 1 hectare, UAH	Conventionally net profit from 1 hectare, UAH	Level of profitability, %
Without fertilizers (control))	3476	3244	93,3
$N_{120}P_{120}K_{120}$	7534	3072	40,8
40 t/ha manure	9379	3011	32,1
$N_{120}P_{120}K_{120}$ + 40 t/ha manure	13433	2667	19,9
$N_{120}P_{120}K_{120}$ + green manure	7741	5594	72,3
$N_{120}P_{120}K_{120}$ + straw	8379	5831	69,6
$N_{120}P_{120}K_{120}$+ straw and green manure	8535	6235	73,0

The highest conventionally net profit was received while using the organic-mineral system of fertilization combined with the use of straw and green manure with mineral fertilizers ($N_{120}P_{120}K_{120}$)– 6235 UAH per hectare, the expenses on cultivation being 8535 UAH per hectare and the level of profitability – 73,0%.

CONCLUSIONS

1. The combined application of green manure, straw and mineral fertilizers in comparison with the control plot without fertilizers increases the crop of sugar beet by 119 %, profit – by 92 % and sugar accumulation by 124 %.

2. At the present stage of the development of agroindustrial sector the use of this system of fertilization is economically profitable alternative to the application of traditional kinds of organic substances.

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Агрохимическая и экономическая оценка альтернативных систем удобрения сахарной свеклы в Западнойлесостепи.

О.В. Шевчук

Показано влияние биологизации систем удобрения на баланс гумуса и питательных веществ,а также продуктивность сахарной свеклы. Установлена экономическая целесообразность совместного использования на удобрение соломы и сидератов на фоне внесения минеральных удобрений.

Ключевые слова: *удобрения, солома, сидераты, навоз, баланс гумуса, баланс питательных веществ, производительность сахарной свеклы.*

АГРОХІМІЧНА ТА ЕКОНОМІЧНА ОЦІНКА АЛЬТЕРНАТИВНИХ СИСТЕМ УДОБРЕННЯ ЦУКРОВИХ БУРЯКІВ У ЗАХІДНОМУ ЛІСОСТЕПУ

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Показано вплив біологізації систем удобрення на баланс гумусу, поживних речовин і продуктивність буряків цукрових. Встановлена економічна доцільність сумісного використання на удобрення соломи і сидератів на фоні мінеральних добрив.

Ключові слова: *удобрення, солома, сидерати, гній, баланс гумусу, баланс поживних речовин, продуктивність буряків цукрових.*