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PRODUCTIVITY OF SUGAR BEET HYBRIDS AS DEPENDING ON PREDECESSOR CROPS AND SYSTEM OF FERTILIZERS

N.S. ZATSERKOVNA, post-graduate*[1]

Institute of Bioenergy Crops and Sugar Beet NAAS

The investigation results of influence of hybrids, chains of rotations and system of fertilizers on sugar beet productivity are presented in the article. It was determined that the highest sugar beet productivity were got after applying jointly Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$ in rotation chain with peas and grooving highly productive hybrid Romul: roots yield – 77,0 t/ha, sugar content – 17,1%, sugar harvest – 13,1 t/ha.

Key words*: sugar beet, precursor crops, doses and forms of fertilizers.*

Introduction. Sugar beet belongs to the industrial crops of intensive type. Getting of high yields of this crop depends on agrotechnical conditions of its growing, rotation chain, view, doses and ways of fertilizers application [4].

Correctly developed system of fertilizers provides intensive growth and development of sugar beet during vegetation period, increases significantly roots yield and provides sugar accumulation. High productivity of sugar beet are got when fertilizers and manure are applied systematically, a favorable nutrient media for crops growing and balanced for nutrients are created in the soil, biological features of this crop and soil-climatic conditions of its growing are counted [5, 7].

Uneven use of nutrients is coursed by different its role in processes of crops growing and development as well as synthesis of sucrose [1, 3]. At the same time the creation of favorable nutrient media in the soil, optimization of it for micro-, mezzo- and macroelements plays important role in forming yield of this crop[2, 6].

Materials and investigation methods. Investigations were carried out on Uladovo-Lulinetska research-selection station of Institute of Bioenergy Crops and Sugar Beet NAAS (Vinnitsa Region, Kalynivka District) during 2011-2013 years.

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[*] **Scientific adviser – doctor of agricultural science, professor E.R. ERMANTRAUT**

Soil of the research plot is leached black soil, deep, low organic matter content, light loam texture.

Agrochemical characteristic of topsoil (0-30 cm): organic matter content (for Turin) – 4,46%, hydrolytic acidity (for Kappen) – 1,03-2,46 mg на 100 g of soil, mobile phosphoric and potassium (for Chirikov) reciprocally – 149 and 94 mg/kg of soil.

Climatic conditions during investigation years were favorable for grow and development of sugar beet.

Investigations were carried out under such scheme:

Factor A. Pre-predecessor of sugar beet:

1. Peas.
2. Clover.

Factor B. ЧС hybrids:

1. Khorol.
2. Romul.

Factor C. Phone of organic and mineral nutrition:

1. Control – without fertilizers
2. Manure 40 t/ha.
3. Parostok 4 t/ha
4. $N_{90}P_{60}K_{90}$
5. 40 t/ha manure + $N_{90}P_{60}K_{90}$
6. Parostok 4 t/ha + $N_{90}P_{60}K_{90}$

Predecessor of sugar beet in all variants of investigation was winter wheat. Whole investigation site area – 50 м^2, site accounting area – 35 м^2, repetition – four-times. Variants for factors “B” and “C” were placed perpendicular at the area, for factor “A” – separate blocks.

Manure and fertilizers were applied in autumn under deep plow. It was used a such fertilizers: ammonium saltpeter (34,5% N), superphosphate simpler granular (19,5% P_2O_5), potassium chloride (60% K_2O).

Experimental investigations were fulfilled in correspondence with methodic of field research [4]. The methods of dispersion, correlation and regression analysis with use of computer programmer Statistica-8 were applied for statistic analysis of investigation results.

Investigation results ant their discussion. When applying manure and fertilizers the yield of sugar beet roots becomes 56,5-75,9 t/ha an average for 2011-2013 years that were more on 26,5-37,5 t/ha in compare with control without fertilizers (table 1).

Application of traditional organic-mineral system of fertilizers (40 t/ha manure + $N_{90}P_{60}K_{90}$) in the chains with clover and peas of grain-sugar beet rotation provided the yield of roots – reciprocally 63,1-66,1 and 65,3-68,5 t/ha. Wherein the yield of hybrid Romul was higher on 3,0-3,2 t/ha in comparing with hybrid Khorol.

The mineral system of fertilizers was less effective. Application of fertilizers $N_{90}P_{60}K_{90}$ provided the yield of sugar beet roots in the chain with clover – 56,5-59,4 t/ra, peas – 57,3-60,1 t/ha. It was determined the decrease of roots yield in comparing with organic-mineral system of fertilizers – reciprocally on 6,6-6,7 and 8,0-8,4 t/ha.

The organic-mineral system of fertilizers were determined as the most effective on the crops of sugar beet which envisages application of Parostok, 4 t/ha instead of manure. When Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$ were applied, the yield of roots of hybrid Khorol in the chain with clover was got – 72,5 t/ha, with peas – 73,5 t/ha; of hybrid Romul – reciprocally 75,9 and 77,0 t/ha. In comparing to control without fertilizers the increase of the yield of roots of hybrid Khorol becomes – reciprocally 35,9 and 35,3 t/ha; of hybrid Romul – 3765 and 36,9 t/ha.

Significantly high yield of roots of sugar beet was got when organic system of fertilizers was applied. Application of 40 t/ha manure increased yield of roots in comparing to fertilizers ($N_{90}P_{60}K_{90}$) on 2,7-3,5 t/ha, of the Parostok, 4 t/ha – on 7,0-8,3 t/ha.

1. Influence of pre-predecessor crops and system of fertilizers on the yield of sugar beet roots, t/ha

Hybrid	Pre-predecessor	System of fertilizers	Year			Medium for 2011-2013
			2011	2012	2013	
Khorol	Peas	Without fertilizers	37,2	35,3	42,0	38,2
		Parostok, 4 t/ha	55,8	61,7	75,5	64,3
		$N_{90}P_{60}K_{90}$	50,6	56,0	65,3	57,3
		Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$	66,2	72,1	82,1	73,5
		40 t/ha manure + $N_{90}P_{60}K_{90}$	58,4	65,0	72,5	65,3
		40 t/ha manure	52,0	57,4	70,5	60,0
	Clover	Without fertilizers	39,3	30,8	39,8	36,6
		Parostok, 4 t/ha	60,3	61,9	71,6	64,6
		$N_{90}P_{60}K_{90}$	52,6	54,2	62,7	56,5
		Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$	66,8	69,8	80,9	72,5
		40 t/ha manure + $N_{90}P_{60}K_{90}$	60,1	60,4	68,7	63,1
		40 t/ha manure	56,4	57,3	65,7	59,8
Romul	Peas	Without fertilizers	39,5	36,8	44,0	40,1
		Parostok, 4 t/ha	58,7	64,7	79,5	67,6
		$N_{90}P_{60}K_{90}$	53,4	58,5	68,4	60,1
		Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$	68,8	75,8	86,5	77,0
		40 t/ha manure + $N_{90}P_{60}K_{90}$	61,2	68,3	76,1	68,5
		40 t/ha manure	54,7	59,9	74,3	63,0
	Clover	Without fertilizers	41,2	32,3	41,8	38,4
		Parostok, 4 t/ha	63,3	65,1	74,6	67,7
		$N_{90}P_{60}K_{90}$	55,4	56,7	66,2	59,4
		Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$	70,2	73,1	84,5	75,9
		40 t/ha manure + $N_{90}P_{60}K_{90}$	62,5	63,8	71,9	66,1
		40 t/ha manure	59,4	59,9	69,4	62,9
$NIR_{0,05}$		hybrid	0,42	0,68	1,24	0,38
		pre-predecessor	0,42	0,68	1,24	0,38
		system of fertilizers	0,73	1,18	2,14	0,67
		general	1,03	1,67	3,03	2,30

Thus, the application of Parostok, 4 t/ha becomes too effective in the system of sugar beet fertilization and its application in combination with recommended dose of fertilizers ($N_{90}P_{60}K_{90}$) allows to reach highest yield.

It worth noting that share of other (uncontrolled) factors influence was within 1%. It confirms the correctness received correlations and veracity of factors influence within experiment.

2. Influence of pre-predecessor crops and system of fertilizers on sugar content in the roots of sugar beet, %

Hybrid	Pre-predecessor	System of fertilizers	Year			Medium for 2011-2013
			2011	2012	2013	
Khorol	Peas	Without fertilizers	17,1	15,4	15,9	16,1
		Parostok, 4 t/ha	17,6	15,8	16,4	16,6
		$N_{90}P_{60}K_{90}$	17,0	15,4	16,1	16,2
		Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$	17,3	15,2	16,1	16,2
		40 t/ha manure + $N_{90}P_{60}K_{90}$	17,3	15,2	16,1	16,2
		40 t/ha manure	17,5	15,7	16,2	16,5
	Clover	Without fertilizers	17,5	15,5	16,2	16,4
		Parostok, 4 t/ha	17,5	15,4	16,3	16,4
		$N_{90}P_{60}K_{90}$	17,3	15,2	16,0	16,2
		Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$	17,4	15,3	16,0	16,2
		40 t/ha manure + $N_{90}P_{60}K_{90}$	17,5	15,3	15,9	16,2
		40 t/ha manure	17,4	15,3	16,0	16,2
Romul	Peas	Without fertilizers	18,0	16,3	16,7	17,0
		Parostok, 4 t/ha	18,5	16,8	17,4	17,6
		$N_{90}P_{60}K_{90}$	17,8	16,1	16,9	16,9
		Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$	18,2	16,0	17,1	17,1
		40 t/ha manure + $N_{90}P_{60}K_{90}$	18,3	15,9	17,0	17,1
		40 t/ha manure	18,4	16,5	17,0	17,3
	Clover	Without fertilizers	18,2	16,3	17,1	17,2
		Parostok, 4 t/ha	18,6	16,3	17,1	17,3
		$N_{90}P_{60}K_{90}$	18,1	15,8	17,0	17,0
		Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$	18,2	16,1	16,7	17,0
		40 t/ha manure + $N_{90}P_{60}K_{90}$	18,3	16,1	16,7	17,0
		40 t/ha manure	18,1	16,1	16,8	17,0
$NIR_{0,05}$		hybrid		0,09	0,11	0,06
		pre-predecessor		0,09	0,11	0,06
		system of fertilizers		0,15	0,19	0,10
		general		0,21	0,27	0,34

Fertilization system and pre-predecessors influenced on sucrose synthesis and its accumulation in sugar beet roots. For applying 40 t/ha manure in the rotation chain with peas in average for 2011-2013 years it was observed the increase of sugar content in sugar beet roots in comparing with control without fertilizers – on 0,3%, for applying Perostok, 4 t/ha – on 0,5%. In the chain with clover when the better

nitrogen regime of soil was formed the sugar content in sugar beet roots in the mentioned variants was at the level of control (table 2).

Application of fertilizers $N_{90}P_{60}K_{90}$ in the chain with peas coursed sugar content in roots at the level of control without fertilizers, in the chain with clover it decreased sugar content in roots in hybrid Khorol – on 0,2%, Romul – on 0,1-0,4%.

3. Influence of pre-predecessor crops and system of fertilizers on sugar harvest, t/ha

Hybrid	Pre-predecessor	System of fertilizers	Year			Medium for 2011-2013
			2011	2012	2013	
Khorol	Peas	Without fertilizers	6,4	5,5	6,7	6,2
		Parostok, 4 t/ha	9,8	9,8	12,4	10,7
		$N_{90}P_{60}K_{90}$	8,6	8,6	10,5	9,2
		Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$	11,5	11,0	13,2	11,9
		40 t/ha manure + $N_{90}P_{60}K_{90}$	10,1	9,9	11,7	10,6
		40 t/ha manure	9,1	9,0	11,5	9,9
	Clover	Without fertilizers	6,9	4,8	6,4	6,0
		Parostok, 4 t/ha	10,6	9,5	11,7	10,6
		$N_{90}P_{60}K_{90}$	9,1	8,2	10,0	9,1
		Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$	11,6	10,7	12,9	11,7
		40 t/ha manure + $N_{90}P_{60}K_{90}$	10,5	9,3	10,9	10,2
		40 t/ha manure	9,8	8,7	10,5	9,7
Romul	Peas	Without fertilizers	7,1	6,0	7,3	6,8
		Parostok, 4 t/ha	10,9	10,9	13,8	11,8
		$N_{90}P_{60}K_{90}$	9,5	9,4	11,6	10,2
		Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$	12,5	12,1	14,8	13,1
		40 t/ha manure + $N_{90}P_{60}K_{90}$	11,2	10,9	13,0	11,7
		40 t/ha manure	10,1	9,9	12,7	10,9
	Clover	Without fertilizers	7,5	5,3	7,1	6,6
		Parostok, 4 t/ha	11,8	10,6	12,8	11,7
		$N_{90}P_{60}K_{90}$	10,1	8,9	11,2	10,1
		Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$	12,8	11,8	14,1	12,9
		40 t/ha manure + $N_{90}P_{60}K_{90}$	11,5	10,3	12,0	11,2
		40 t/ha manure	10,8	9,6	11,7	10,7
$NIR_{0,05}$		hybrid		0,10	0,23	0,08
		pre-predecessor		0,10	0,23	0,08
		system of fertilizers		0,18	0,41	0,13
		general		0,25	0,57	0,47

Application of organic-mineral and organic systems of fertilizers did not allow to receive sugar content in roots higher than at the control in the chain with clover. Additional accumulation nitrogen in the soil at these variants by symbiotic nitrogen-fixing strengthened nitrogen nutrition of sugar beet and accompanied by decrease of sugar content in roots.

The results of investigations confirmed well-known correlations that high phones of nitrogen nutrition decrease sugar content in roots. At the same time application of organic fertilizers positively influenced on sugar content in the sugar beet roots.

The most important indicator of efficiency of technology of sugar beet growing becomes sugar harvest per unit area which integrally combines crops yield and sugar content in the roots.

The results of investigations show that for indicator of sugar harvest the mineral system of fertilizers significantly inferior to organic-mineral systems. For combined application of organic and fertilizers the sugar harvest in the chain with clover at the average for 2011-2013 years becomes 10,2-13,1 t/ha that in comparing to application $N_{90}P_{60}K_{90}$ was more on 1,0-3,9 t/ha. In the chain with peas it was observed the same correlation – the increase of sugar harvest in comparing to mineral system of fertilizers was 1,4-2,9 t/ha (table 3).

When 40 t/ha manure was applied the sugar harvest for both pre-predecessors of sugar beet growing was less on 0,5-1,3 t/ha in comparing to organic-mineral system of fertilizers. Thus, application of traditional manure does not allow to cover all crops requirements in nutrients and provides maximum its productivity.

Conclusions. The highest productivity of sugar beet was got when Parostok, 4 t/ha + $N_{90}P_{60}K_{90}$ was applied. In the chain with peas the yield of roots became 73,5-77,0 t/ha, sugar content – 16,2-17,1%, sugar harvest – 11,9-13,1 t/ha; in the chain with clover – reciprocally 72,5-75,9 t/ha, 16,2-17,0% and 11,7-12,9 t/ha. Sugar harvest in the chain with peas was higher on 0,2 t/ha than in chain with clover.

For organic-mineral system of fertilizers the hybrid Romul showed higher productivity at the sufficient moisture conditions. Application of Parostok, 4 t/ha +

$N_{90}P_{60}K_{90}$ for hybrid Romul increased sugar harvest in the both chains of crops rotation in comparing to hybrid Khorol on 1,2 t/ha.

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