

## The selection of energy-efficient main processing of the soil for sugar sorghum

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**Abstract.** The implementation of any culture is the basic processing of soil are given great attention, as it largely affects the water-physical, biological and agricultural properties of the soil that ultimately determines yield.

Analyzing the prospects and contradictions of minimizing tillage, many scientists warn against the danger of simplifications and patterns. They note that the current campaign, in contrast to the former, the party-state, has a market-chinovnichny character. The initiative in it belongs to suppliers of pesticides and equipment. Instead of the state agrotechnological policy, based on the recommendations of scientists, the society is imposed a new style of market self-regulation of technological support of agriculture, which is a serious economic and environmental danger. Moreover, the advantages of the minimum and even zero tillage are advertised without serious indications of shortcomings that must be overcome by the system of agricultural enterprises.

Zero and close to it treatments are effective only in the conditions of plain relief, scarce water regime and relatively prosperous soils with respect to water permeability. The correct system of tillage is a rather knowledge-intensive task that requires professional training of specialists.

Thus, at the beginning of the century, the technology of tillage had almost two points of view: one proved the need to minimize it, and the other – to increase the intensity. Preference was given to the second direction, which entailed the intensification of treatment (including additional techniques, increasing the depth).

Field experiments on the study of basic tillage techniques were carried out in 2013-2015 according to the scheme:

1. Moldboard plowing to a depth of 22-24 cm, the plow PN-5-35;
2. The Maltsev plowing on 22-24 cm;
3. Processing the combined unit APK-6, 22-24 cm;
4. Treatment with anti-erosion cultivator KPE-3,8 20-22 cm.;
5. Treatment with a heavy cultivator KTS-10 20-22cm .

The results of the determination of contamination of crops which had been counted just before harvest showed that the lowest weed infestation was on the variant with a moldboard plow (16-24 PCs/m<sup>2</sup>).



The highest contamination observed when conducting primary tillage KPE-3,8 (49-55 pieces/m<sup>2</sup>) and CBS-10 (49 to 56 pieces/m<sup>2</sup>). Among the weeds was dominated by oat grass and chicken millet (figure 1).

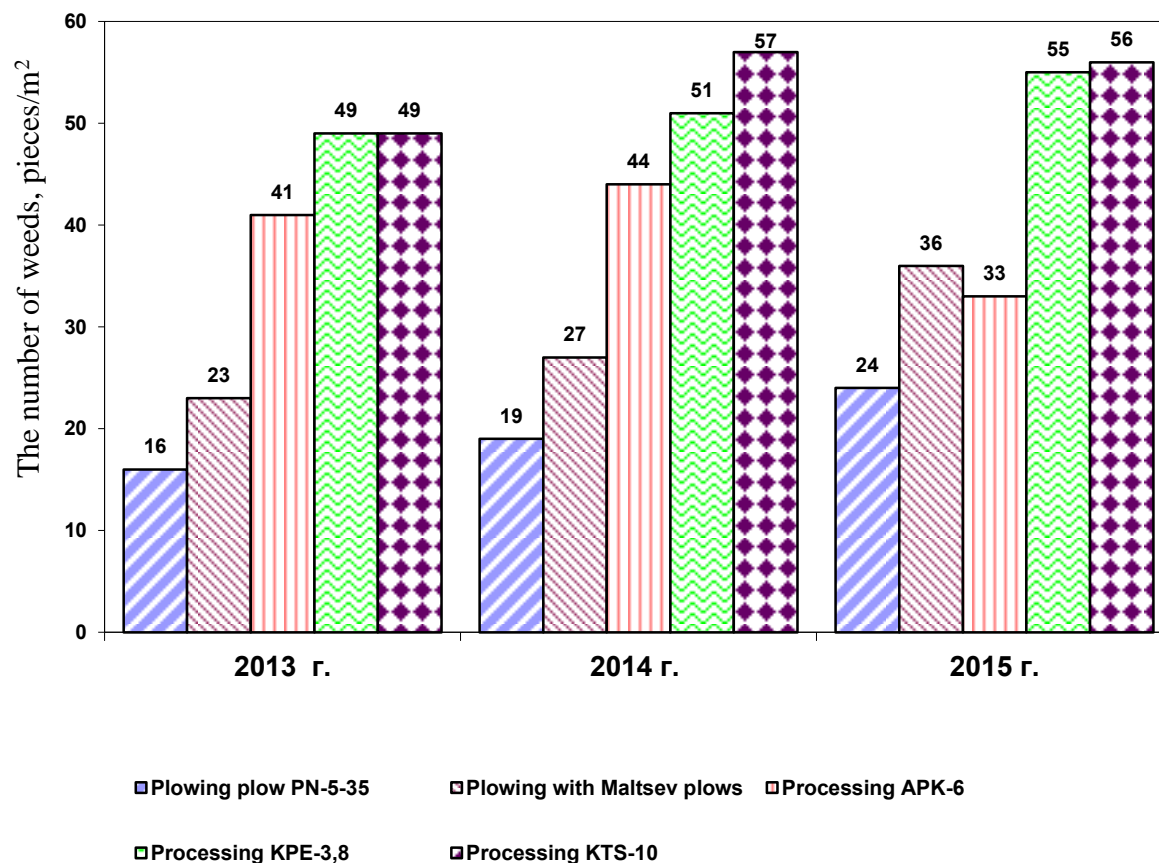


Figure 1-Clogged sorghum crops depending on the methods of basic tillage, PCs / m<sup>2</sup>

In our studies, the density of the addition of soil before sowing sorghum on the variants of soil tillage there was no significant difference, however, before the cleaning layer 10-30 cm soil was denser on the options in the processing of APK-6, KPE-3.8 and CCC-10 (table. 1).

Table 1 – the density of the composition of the soil depending on processing systems, g/cm<sup>3</sup>

Basic tillage	Before sowing				Before harvesting			
	0-10cm	10-20 cm	20-30 cm	0-30 cm	0-10 cm	10-20 cm	20-30 cm	0-30 cm
Plowing plow PN-5-35	1,06	1,12	1,14	1,11	1,08	1,15	1,17	1,13
Plowing with Maltsev plows	1,07	1,13	1,16	1,12	1,10	1,17	1,20	1,16
Processing APK-6	1,09	1,16	1,20	1,15	1,14	1,22	1,25	1,20
Processing KPE-3,8	1,08	1,14	1,18	1,13	1,12	1,20	1,23	1,18
Processing KTS-10	1,08	1,15	1,19	1,14	1,13	1,21	1,24	1,19

Analyses have shown that hardness of soil layers depended on systems of processing of the soil and degree of its moistening (table. 2). The data of table 2 show that in the layer 0-15 cm between the processing systems, this figure does not differ significantly, and at a depth of 20 cm and below it was higher in the plots of flat-cut loosening.

Table 2 – Hardness of soil in different systems of soil treatment, g/cm<sup>3</sup>, 2013-2015

Basic tillage	In the early growing season					Before harvesting				
	5 cm	10 cm	15 cm	20 cm	25 cm	5 cm	10 cm	15 cm	20 cm	25 cm
Plowing plow PN-5-35	2,9	5,2	14,1	17,1	30,2	12,1	18,5	27,3	32,1	33,8
Plowing with Maltsev plows	3,0	5,3	14,4	18,0	30,3	12,6	19,3	28,2	33,5	35,1
Processing APK-6	3,2	5,7	16,5	22,1	31,6	13,4	22,3	34,1	37,6	41,4
Processing KPE-3,8	3,0	5,4	15,6	20,1	30,5	12,9	21,2	31,8	36,3	38,2
Processing KTS-10	3,1	5,5	15,8	20,3	30,7	13,0	21,4	32,9	36,7	40,1

In experiments conducted systematic observations of the state of the soil nutrient regime. Three times during the growing season for three years on two layers of the arable layer in a two-fold replications carried out tests to determine the content of each of the major nutrients – NO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>, and K<sub>2</sub>O in the soil, we removed (15 definitions) the average for the 3 years in terms of layers of 0-15, 15-30 and 0-30 cm. In the result of application of APK-6, KPE-3,8, KTS-10 sown pronounced differentiation of the parts of the arable layer fertility. In the layer 0-15 cm content of P<sub>2</sub>O<sub>5</sub> on the dump treatment was 164 mg/ kg, in the processing of APK-6-176 and CCC-10-173 mg/ kg, K<sub>2</sub>O 179,186 and 184 mg/ kg respectively. Exceeding version APK-6 P<sub>2</sub>O<sub>5</sub>-12, K<sub>2</sub>O-15 mg.

Alkali-hydrolysis nitrogen by plowing contained 78 and for the soil treatment unit LDC-10 – 85 mg/kg soil. In the underlying layer (15-30 cm) opposite pattern. Plowing discovered 71 mg, and while tilling the CCC-10 – 55, P<sub>2</sub>O<sub>5</sub> 150 and 133, respectively, K<sub>2</sub>O – 161 and 150 mg/kg.

Consequently, the applied fertilizers, especially phosphoric and potassium ones at flat-cut loosening, are mainly retained in the upper (0-15 cm) layer and in the lower (15-30 cm) layer penetrate in much smaller quantities than is the case with plow treatment.

Further increase in feed production requires coordinated measures, the most important of which are: the creation of a biologically full-fledged and economically viable feed base, taking into account the achievements of intensification.

The greatest economic efficiency in the cultivation of sugar sorghum is obtained with the use of plowing. Net income on this option amounted to 1964 RUB/ha, profitability level of 64.3%, the energy efficiency ratio of 6.7 vs 383 - 1426 RUB./ha, 13.4 to 48.3 per cent and 4.4 to 5.7 obtained on other options.

In recent years, bioenergy assessment of agrotechnological operations, which is presented in table 3, has become increasingly important in the world practice.

Table 3-Energy assessment of basic tillage in sorghum cultivation

Basic tillage	Productivity of green mass, t/ ha	of Saved up energy, GJ / ha	of Spent energy, GJ / ha	Energy efficiency coefficient	BEP agro-ecosystems
Plowing plow PN-5-35	41,1	189,88	30,23	6,3	4,5
Plowing with Maltsev plows	35,9	165,86	29,11	5,7	2,6
Processing APK-6	26,5	122,43	28,01	4,4	1,1
Processing	31,4	145,07	27,91	5,2	1,7

KPE-3,8					
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It allows to compare different technologies of production of agricultural products. The highest (6,7) in the experiment the coefficient of energy efficiency was obtained in the treatment of soil ploughs PN-5-35, the lowest (4,4) he was in the treatment of soil combined unit APK-6. Bioenergetic indicator of agroecosystem (BEP), these options amounted to respectively 4.5 and 1.1.

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