Energy-saving technologies of cultivation of sugar sorghum

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Abstract. The article describes the main elements of energy-saving technologies of cultivation of sugar sorghum, which, in particular, is the introduction of the combined units. Integrated units allow for one pass across the field to perform up to eight operations, thereby ensuring a significant reduction in energy costs, but there are certain negative points.

The current stage of development of agricultural production is characterized by high rates of growth of farm equipment means of production, in particular energoosnaschennoy technique. At the same time there is a problem of rational use of available technology with sufficient effectiveness. In this connection, in the current economic conditions, the transition to a qualitatively higher level of productivity, profitability, resource and energoberezhlivosti, environmental safety associated with the use of energy-saving technologies.

The introduction of new technologies has become a priority not only because they contain the results of the new achievements of domestic and foreign researches in the field of creation of new equipment and technologies for agriculture, but also because it is necessary to solve at this stage of economic development new challenges: improving the competitiveness of agricultural products on domestic and foreign markets; increasing environmental safety; reduction of soil degradation processes, etc.

Before the formation of market relations in agrarian sector of economy the main direction of increase of productivity was the feeding of the fleet farms in the production of modern mechanization, it was observed a steady trend towards increasing energy intensity of agricultural production. The increase in growth of gross output of agriculture by 1% was achieved by increasing 1,8% and 2,7%
used generating capacity. The analysis shows that since the beginning of 2000-ies of the increased energy consumption of the means of production, as agricultural production along with the traditional energy sources (oil, gas, electricity) began to use solar energy, energy of biomass and waste energy. The energy cost of producing 1 ton of conventional grain units in Russia compared to the United States more than 5 times, this is partly due to the fact that agricultural production in Russia operates in less favorable climatic conditions.

The results of previous years proved that the process of intensification in the agricultural sector is closely linked with the growth of energy consumption. Including energy-intensive methods of cultivation of sugar sorghum significantly increase the value of products received, so priority in the organization of production of sweet sorghum should be allocated to the development of resource-saving technologies.

Currently, the energy intensity of production acts as a factor of competitiveness of made production. In this connection it is necessary to create conditions for the effective formation of a highly mechanized units, require the development of models and methods of substantiation of effective structures of agrarian formations, optimization of production technology and management, rational organization of labor and logistics.

To solve the problem of energy saving in agricultural production it is necessary to solve three tasks: to adopt and gradually implement the organizational-economic and legal activities; to implement energy-saving technologies with wide use of secondary energy resources; to change the machine technology with a dramatic reduction in energy costs.

Technology of cultivation of each culture, like art, is based on a set of techniques aimed at ensuring the most favorable conditions for the growth and development of plants. Increasing the productivity of sugar sorghum is also associated with systemic approach to the cultivation of this crop, which is based on the achievements in the fields of science, engineering, technology and complex application techniques. A set of techniques covers all manufacturing operations performed since the release of the precursor fields to harvest, inclusive, starting with primary and secondary tillage. These techniques need to pay attention as to effects on biological, chemical and physical properties of the soil they are universal. By mechanical action only created the conditions for the development of the root system of cultivated plants, the efficiency of fertilizers etc. the Conducted research allows to claim that up to 25% of the crop is formed by the main processing of the soil. At the same time, the cultivation of sweet sorghum is one of the labor-intensive farming practices on its implementation consumes up to 40% energy and up to 25% of the workforce [1,2,3,4].

Summary tillage involves substantial costs for fuel and lubricants, which constitute up to 30% at various technologies.

Currently in crop production will radically change the approach to the application of technologies of cultivation of crops in order to significantly reduce energy costs. With the aim of reducing energy costs, while the basic processing of soil are used resource-saving soil treatment methods, among which ploskorezy tillage, small share plowing, diskning. Studies show that strukturalnych fertile soils conservation treatment compared to the plowing does not reduce the yield of crops, more fuel consumption if you decrease the depth by 1 cm decreases 1 L. In agricultural production in the Republic of Tatarstan introduced the crop combined aggregates, which in one pass across the field is carried out six to eight operations: harrowing, fertilizing, cultivation, leveling the soil, sowing, crop compaction. As a result, combined sowing units in comparison with the separate application of methods of seedbed preparation reduce energy costs at planting. So, fuel consumption on average when sowing with combined sowing machine "Victoria" on stubble background in SPK Alga Alekseevskogo municipal district decreased by 8,1 kg/ha [5,6].

In this regard, the development and introduction of energy-saving systems the main processing of the soil in the cultivation of sweet sorghum focused, in particular, to minimize the cost of fuel and lubricants, providing the economic effect, contributing to the achievement of environmental security is timely. In mixed economy, different security groups agricultural production resources necessary to develop different technology options [7,8,9,10].
Classic technology (moldboard) cultivation of sweet sorghum involves periodic or annual plowing with a turnover of formation, repeated passages of agricultural equipment in the field. The consequence of this technology is at a certain level of soil compaction, destruction of its mechanical structure, and as a result water and air erosion, reduction of fertile soil. Consequently, all this leads to disruption of natural ecological balance, pollution of the environment. [11,12,13].

Currently, in all regions of the country, the intensive search of new technological methods of primary tillage to reduce the impact of these consequences, preserving and improving soil fertility, reducing labor and energy costs. [14].

Developed and widely implemented comprehensive techniques, which are based on substitution of ploughing with other types of cultivation, minimum tillage or partial replacement of moldboard moldboard plowing, as plowing is consumed over 50% of the fuel and lubricants, therefore, this is a significant source of savings.

The cultivation of sweet sorghum were tested the technology of direct seeding, which is based on moldboard plowing chisel, the characteristics given in the table.

Table 1 – Cost analysis for various options of cultivation of sugar sorghum

| Technological operations | The applied technique                                      | Quantity, pcs | Cost, thous.rub. | Personnel | Cost items, rub. | Total, thous.rub. | Cost structure, % |
|--------------------------|------------------------------------------------------------|---------------|-----------------|-----------|-----------------|------------------|------------------|
|                          |                                                             |               | Plow depleted PRUNE-8-45 | 3 4 | 16500 2000 | 3 7000 57600 51840 | 116440 | 36,4 |
| Harrowing                | Tractor MT31221 Harrow heavy                               | 1 1           | 1400 1000       | 1 1 | 800 6300 | 452 | 7552 | 2,4 |
| Combined seeding         | Tractor K-744 Seeding complex "Agrator 12200"              | 1 1           | 2920            | 1 1 | 4000 11700 | 10530 | 26230 | 8 |
| In total                 |                                                            | 13 6          | 30480 33250 86420 | 77760 | 320000 | 100 |
| The technology of        |                                                             |               |                 |           |                 |                  |                  |
|                          | Tractor K-744 The Disc Header "Дискомастер 9*4"            | 1 1           | 5500 1160       | 1 1 | 1500 6300 | 5670 | 13470 | 6,9 |
| Disking                 | Tractor K-744 The Disc Header "Дискомастер 9*4"            | 1 1           | 5500 1160       | 1 1 | 1500 6300 | 5670 | 13470 | 6,9 |
| Moldboard plowing chisel | Tractor K-744 Chisel plough "Kizilmescit 6000"             | 1 2           | 5500 1100       | 1 1 | 800 18000 | 16200 | 35000 | 18,0 |
Harrowing
Tractor MT31221
Harrow heavy

Combined seeding
Tractor K-744
Seeding complex "Agrator 12200"

|                | Tractor Model | Quantity | Depth 1 | Depth 2 | Depth 3 | Depth 4 | Depth 5 | Depth 6 | Depth 7 |
|----------------|---------------|----------|---------|---------|---------|---------|---------|---------|---------|
| Harrowing      | MT31221       | 1        | 1400    | 3920    | 11700   | 10530   | 26150   | 135     |
| Combined seeding| K-744         | 1        | 2920    | 4000    | 11700   | 10530   | 26230   | 135     |

In total

|                |                |         |         |         |         |         |         |         |         |
|----------------|----------------|---------|---------|---------|---------|---------|---------|---------|---------|
| Total          |                | 18580   | 5       | 1550    | 56800   | 51120   | 194000  | 100     |

Combining tillage with seedbed treatment allows for a 9-14% reduction in the cost of fuel and lubricants and improve the quality of soil preparation for planting sweet sorghum, this is achieved by aggregation with the plough "Kizilmescit 6000". In General, the combination of technological operations the basic and pre-treatment into a single process allows you to save 25-30% of fuel and lubricants, labor resources compared to separate these operations.

However, when you switch to energy-saving technologies arise and negative aspects, in particular excessive soil compaction, resulting in deterioration of the permeability malagasyrepublic, heavy structureless soils. Therefore, the technology of direct seeding should be used in the crop rotation without row crops with a humus content of not less than 3%, the structural nesoplivye soils. In addition, the problem arises with plant residues. With their large numbers, uneven distribution across the soil surface there is a problem with the placement of seeds at a reasonable depth. In these cases, should be aggregated complexes with disc coulters. Practical experiments show that the disk coulters are less clogged with straw and easier to penetrate the surface. While crop residues and rhizome are located and stored in the upper soil layers and not in the entire arable horizon, thereby enhancing the potential of soil fertility, accumulation of soil moisture.

Overall, the transition to energy-saving technologies in cultivation of sweet sorghum enables to improve its economic indicators:
- to increase productivity, to reduce the need for labor resources;
- reduce cost of fuel and lubricants by 25-30%, and all costs of the whole technological cycle of cultivation of sugar sorghum for 9-14%;
- to reduce the cost of acquisition and operation of tractors and agricultural machines. The cost of service and maintenance with technology of direct seeding in comparison with the classical technology are reduced by 34.3%;
- there is a cost savings to prevent wind and water erosion of soil;
- increases fertility and soil blagodarenie;
- reduced environmental pollution.

Thus, the use of energy saving technologies in agriculture should contribute to the solution of problems of reduction of the direct and total energy costs and increase production.

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