

# THE USING OF ENERGY SAVING TECHNOLOGIES IN GROWING CROPS

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The author considers the process of growing crops as a complex of interrelated technological operations performed in a specific sequence using a system of machines according to parameters of influence on the land properties with the using workforce, working capital (seeds, gasoline, diesel fuel, electricity, mineral and organic fertilizers, pesticides) for crop production.

The production process combines three components: 1) production operations; 2) materials and technical equipment for the production operations' implementation; 3) quantitative and qualitative parameters for the production operations' implementation.

Technological operations are completed parts of the production process, including: 1) basic soil tillage; 2) presowing tillage and sowing; 3) crops caring; 4) harvesting.

Technological operations are interdependent, as none of them could be executed before the previous one. The quality of production operations depends on the skill level of employees, production planning, it organizing, the level of labor discipline, it motivation, accounting and control.

The most active part of the production process is the labor assets, which directly affect the economic and energy efficiency of growing crops. Changing technology is due to the corresponding change of the complex interconnected operations with more efficient systems of machines (new designs of machines and tools).

Technological parameters are quantitative and qualitative implementation indicators of technological operations by the machines and tools system.

Technological parameters of growing crops are influenced by natural (photosynthetic solar radiation level, temperature, rainfall, soil fertility) and artificial factors (machines system, hybrids, sowing, sowing terms, timing and methods of harvesting).

The author considers energy saving technologies in growing crops as a complex of interrelated operations that provide minimum energy cost per unit of production at the highest output:

$$\hat{A}M_i = \frac{E_{C_i}}{O_i} \Rightarrow \min, Y_i \Rightarrow \max, \quad (1)$$

where  $EM_i$  – the energy intensity of growing  $i^{\text{th}}$  crop technology, MJ / ctr;

$E_{c_i}$  – total costs of energy resources using per 1 ha of the  $i^{th}$  crop sowing, MJ;

$Y_i$  – the yield of the  $i^{th}$  crop, ctr / ha.

The following tasks could be solved during the energy efficient technologies using in growing crops:

1) the reducing of total costs of energy resources using per unit of cultivated area at a constant  $i^{th}$  crop yield:

$$E_{c_i} \Rightarrow \min, Y_i = Y_{\alpha_i}, \quad (2)$$

where  $E_{c_i}$  – total costs of energy resources using per 1 ha of the  $i^{th}$  crop sowing, MJ / ha;

$Y_i$  – the yield of the  $i^{th}$  crop, ctr / ha;

$Y_{\alpha_i}$  – the  $i^{th}$  crop yield at the lowest costs of total energy using, ctr / ha;

2) the  $i^{th}$  crop yield increasing at the same total energy costs per unit of cultivated area:

$$E_{c_i} = E_{\alpha_i}, \dot{O}_i \Rightarrow \max, \quad (3)$$

where  $E_{c_i}$  – total costs of energy resources using per 1 ha of the  $i^{th}$  crop sowing, MJ / ha;

$E_{\alpha_i}$  – total costs of energy resources using per 1 ha of the  $i^{th}$  crop sowing at the yield level increasing, MJ / ha;

$Y_i$  – the yield of the  $i^{th}$  crop, ctr / ha;

3) the  $i^{th}$  crop yield increasing during the reducing of total energy costs per unit of cultivated area:

$$E_{c_i} \Rightarrow \min, \dot{O}_i \Rightarrow \max, \quad (4)$$

where  $E_{c_i}$  – total costs of energy resources using per 1 ha of the  $i^{th}$  crop sowing, MJ / ha;

$Y_i$  – the yield of the  $i^{th}$  crop, ctr / ha.

As follows, the energy intensity of growing crops technology depends on the number and nature of production operations. The energy accumulated in the yield increases faster than energy costs with the using of advanced technological processes. However economic and energy efficiency of crop production increases with the technologies improvement and the implementation of energy efficient machines system (new designs of machines and tools).

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