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Layered Combined Soil Cultivation: Is The Basis Of Resource Saving In Field Cultivation.

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ABSTRACT

This article presents the results of the development of combined aggregates and working elements for layerwise tillage. It is established that the application of the developed combined tillage machines in the majority of their monoblock type, equipped with adaptive complexes of working bodies in the unit with modern power means, provides a significant reduction in the costs of living labor, specific fuel consumption and money resources in the complex of mechanized works for cultivation major agricultural crops in the southern region of Russia.

Keywords: layered tillage, cultivation, sowing, cereals, mechanization of crop production.

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INTRODUCTION

The steppe zone of the North Caucasus and the Volga region is characterized by uneven precipitation throughout the year, long, warm and dry in summer. Maximum precipitation can be observed in any of the months of the year.

In arid years, using traditional methods and technical means, it is impossible to keep moisture in the 10-12 centimeter layer on the steam fields, prepare the soil for sowing winter crops on non-steam predecessors, and prepare the soil qualitatively for the next year's harvest [1, 2]. Southern chernozems, possessing the ability to run off at high temperatures when performing basic and shallow processing, form a cobble surface that persists until the spring and requires additional resources to crush blocks and level the surface of the field. In this case, it is necessary to additionally use disc tools, cultivators, rollers, levelers, etc., which leads to a sharp increase in the energy intensity of the technology as a whole [3, 4].

Current conditions in the agro-industrial sector set mandatory requirements for both the technological processes being developed and the technological means for their implementation.

These are requirements:

Ecological - protection of soils from wind and water erosion; prevention of pollution by pesticides, preservation and accumulation of a fertile layer of soil; preservation and accumulation of moisture.

Economic - resource saving (in the broadest sense) - reducing fuel consumption per unit of output; reduction of labor costs; reduction in the total energy intensity and resource consumption in the production of agricultural products.

All these requirements acquire special rigidity in conditions of limited monetary and material resources.

Technological processes of soil cultivation, based on the use of single-operation machines (lushchilnikov, plows, cultivators, seeders, rollers, etc.) do not allow in conditions of arid farming, and not only, to obtain the required quality and any appreciably reduce the resource consumption, complexes of machines and especially their number.

Moreover, the unjustified application of deep soil treatments for winter crops also does not contribute to resource saving in the context of machine technologies for cultivating such crops [5].

So, according to the data of the Stavropol Scientific Research Institute, in comparison with the combined shallow and superficial tillage of the soil, the yield of winter wheat declines by plowing by 3-5 c / ha.

The aim of the research is to develop combined aggregates and working elements for layer-by-layer tillage.

RESULTS AND DISCUSSION

Taking into account the aforementioned, there is no alternative to combined machines and aggregates that provide layer-by-level soil cultivation with the required quality in one pass [6, 7].

Figure 1 shows the technological scheme of the soil horizon treated by a layer-wise slit ripper [8].

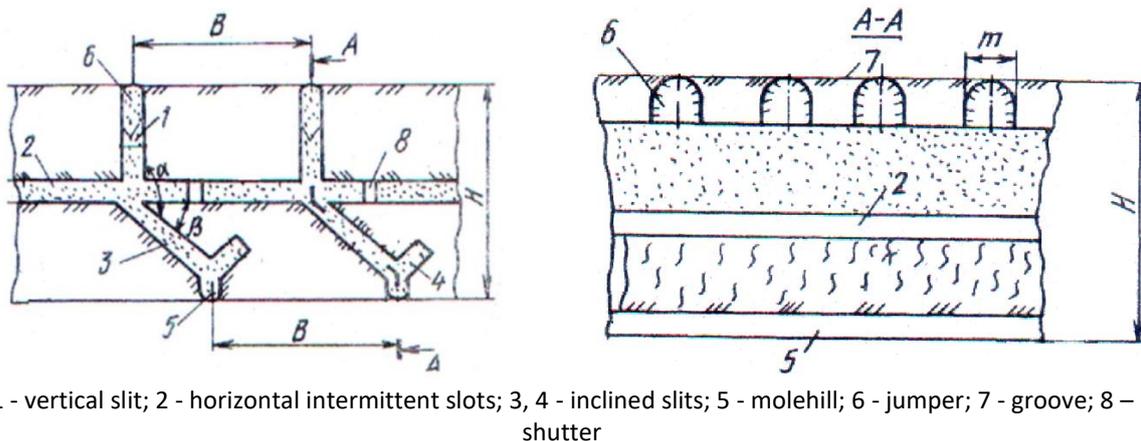


Figure 1: Technological scheme of the soil horizon

The soil horizon thus treated ensures the decomposition of the treated layer without turning the formation and clod formation, the formation of water-absorbing cracks, which is especially important for regulating all types of water drains, the required moisture and air permeability, prevents the development of wind and water erosion. With this treatment, a significant reduction in specific energy costs is ensured. Figures 2 and 3 show the working organs and combined tools developed for these purposes with new working bodies for power facilities of traction classes 3 and 5 [9, 10, 11].

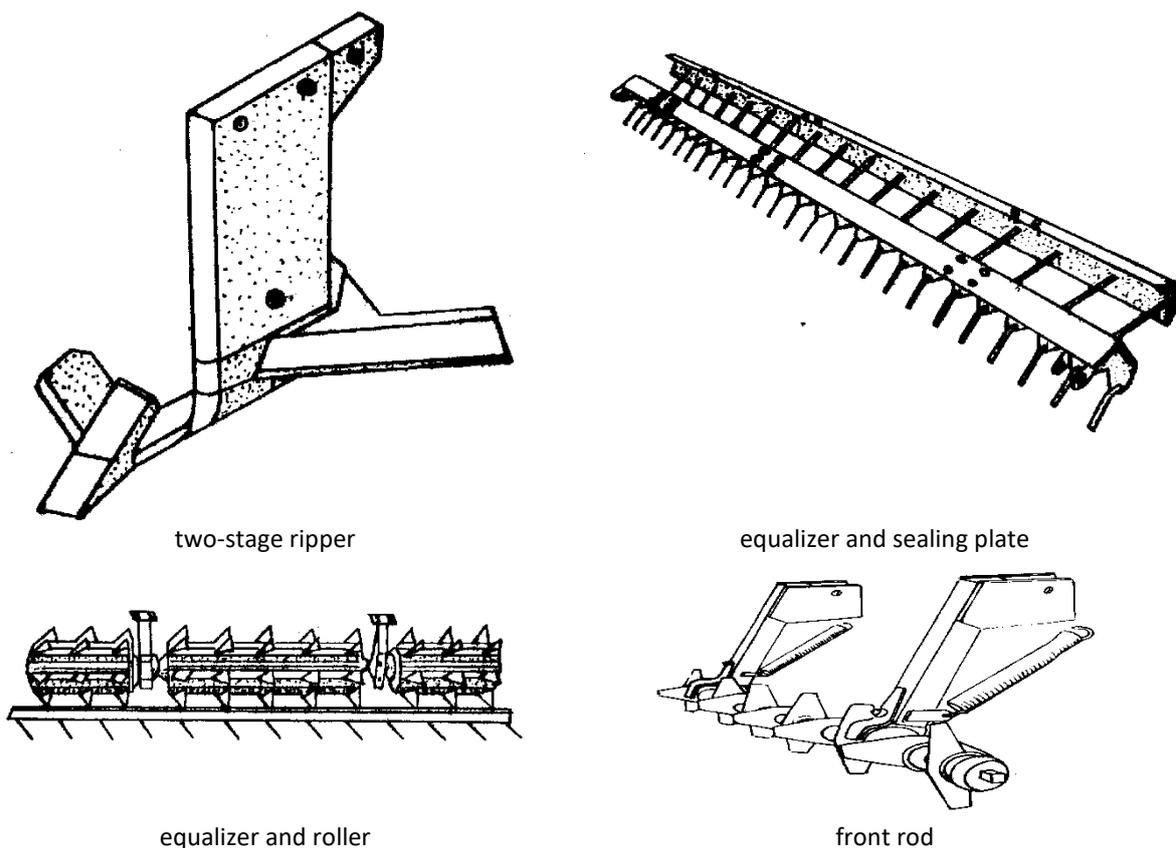


Figure 2: Working elements for layerwise deep loosening of soil

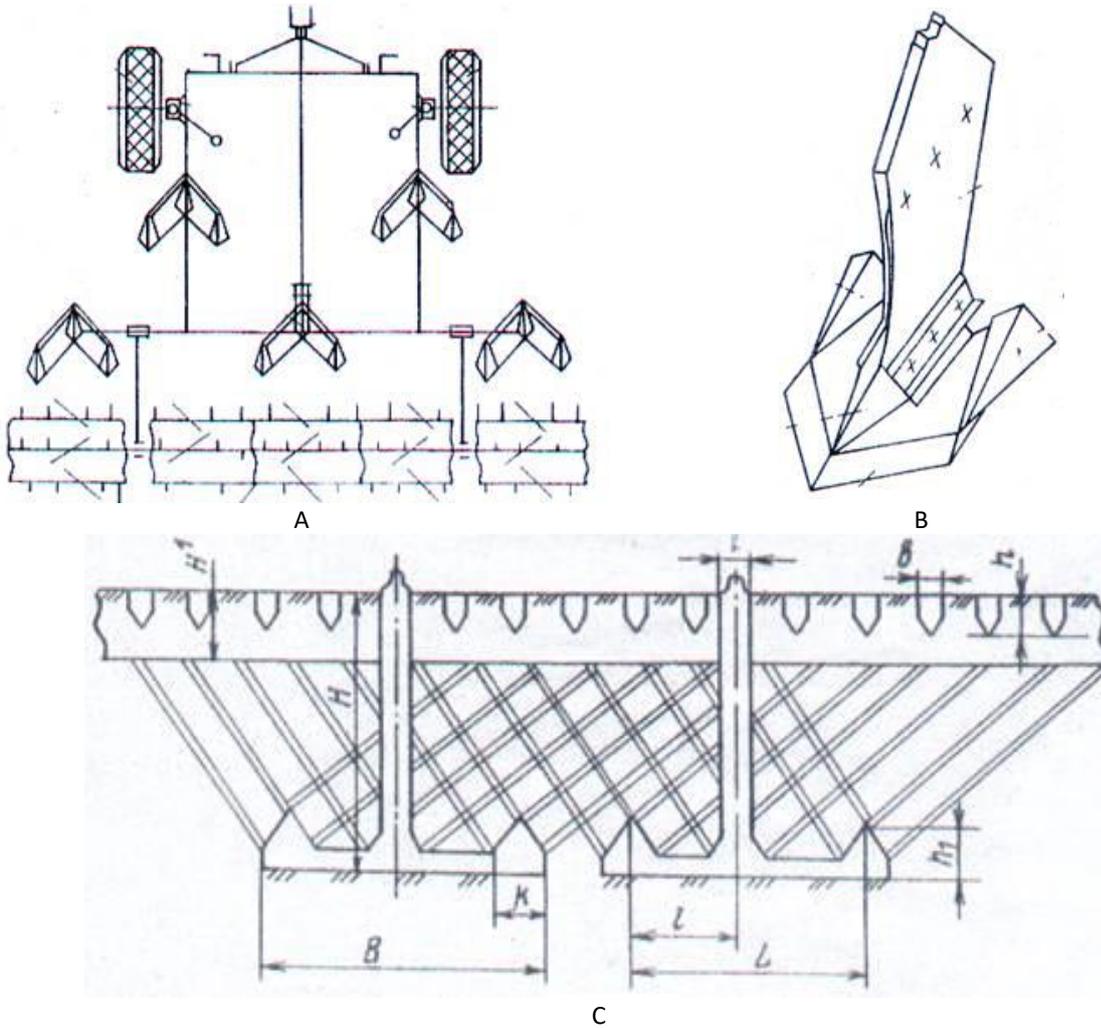


Figure 3: Combined tools with new working elements for traction power facilities 3 and 5

When the soil is treated with such tools to a depth of 35 cm in comparison with plowing, fuel consumption per hectare is reduced by 25%.

Figure 4 shows the cross-section of the treated soil layer and the structural-technological scheme of the combined tool with the frontal arrangement of new working elements for layered deep processing (up to 35 cm) including slope sections [12, 13].

With the operation of such a tool, even on the slope, the main working organ besides loosening (shrinkage of the soil layer is replaced by its stretching) ensures the formation of intestinal molehills absorbing surface storm drains, as well as sludge from meltwater.



a - a tillage unit; b - main working element; c is the cross section of the treated soil layer

Figure 4: Scheme of the working organ and structural-technological diagram of the combined implement

In addition, the developed main working body can be used to dry over-wetted backgrounds (for example, after flooding with groundwater) for subsequent planting of crops, and such a working organ efficiently operates on over-dried backgrounds, without the formation of soil blocks.

An additional working organ in the form of a drum-shredder crushes the soil clods, and mulches the treated surface.

According to this constructive technological scheme, combined soil cultivating units for power facilities of traction classes 3 and 5 have been created (Figure 5).





Figure 5: Combined tillage aggregates for energy resources of traction classes 3 and 5

The need to create and use combined machines and tools for combined shallow and surface tillage for winter crops with a complete technological cycle can be illustrated by the following example.

The studies carried out by the authors showed that the use of combined aggregates for preparing the soil for winter crops makes it possible to reduce the total energy expenditure per 1 hectare of the cultivated area by almost two times as compared to the energy spent in preparing the soil for winter using separate single-operation machines (peeling, plowing, cultivation), not to mention On the qualitative indicators of the compared technological processes.

On the basis of the requirements for technological processes of shallow and superficial tillage, combined tillage aggregates were created, providing layer-by-layer tillage of the aggregate to a depth of up to 16 cm in one pass.

Technological schemes of variants of the combined soil cultivating unit are presented in Figure 6 [14].

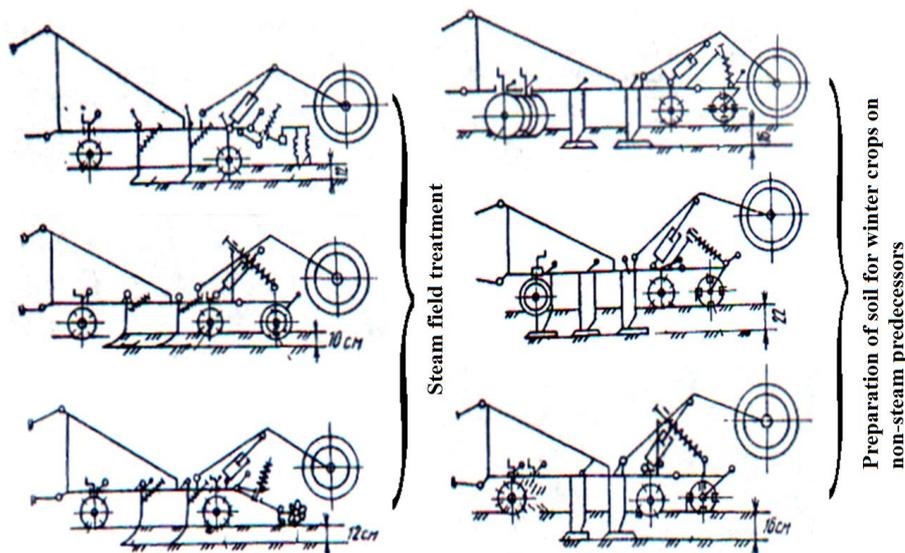


Figure 6: Possible technological schemes of combined tillage aggregates

Combined units made according to the proposed schemes for tractors of traction classes 3 and 5 are shown in Figure 7 [14, 15, 16, 17].

Summarizing the foregoing, it should be noted that machine technologies based on combined machines and aggregates may have a shorter technological chain of operations due to the possibility of combining, in an agro-technical framework, the necessary operations for tillage, tillage and fertilization, tillage and sowing. At the same time, the minimum permissible calendar dates for performing operations, the requirements of agrotechnics for quality parameters of the treated layer, preservation of soil moisture, and minimizing the harmful effect of running mobile energy systems (MES) on the soil are provided.



Figure 7: Combined units made according to the proposed schemes for tractors of traction class 3 and 5

Taking into account the high degree of adaptability of the developed combined machines and aggregates to the environmental conditions, it becomes possible to carry out soil cultivation, especially for sowing winter crops on non-steam predecessors, even in conditions with the required quality that are extremely hard and moist.

In this case, several technological operations can be replaced by one without violating the requirements of agricultural technology (Figure 8).

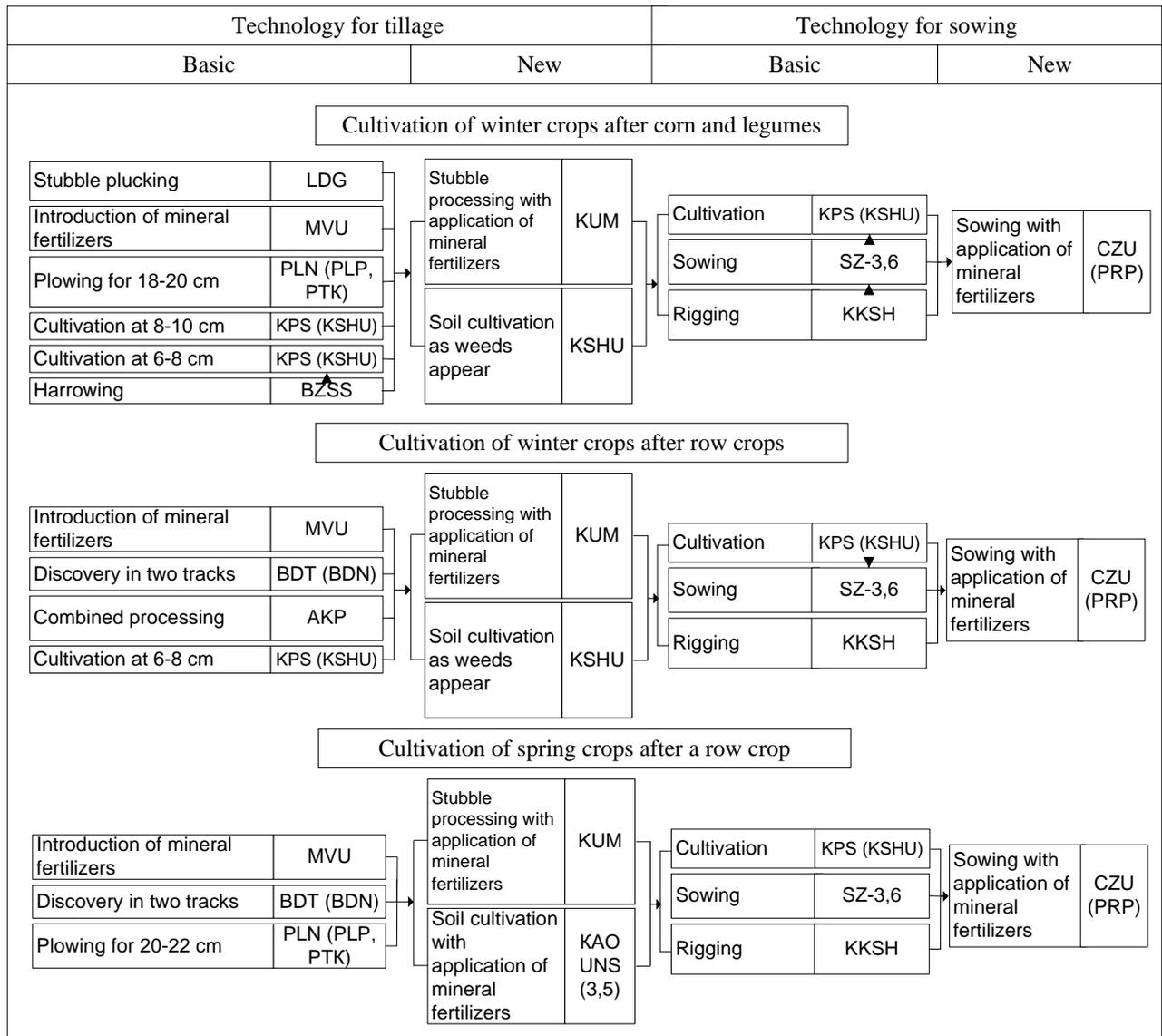


Figure 8: Content of basic and prospective new technologies for tillage and sowing of basic crops in typical rotations of the southern steppe zone

CONCLUSION

The use of developed combined tillage machines in the majority of their monoblock type, equipped with adaptive complexes of working organs in the unit with modern power means, provides a significant reduction in the costs of living labor, specific fuel consumption and money resources for a complex of mechanized works for the cultivation of basic crops southern region of Russia.

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