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Comparative Analysis Of The Main Parameters Of Cultivators

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ABSTRACT

This article presents a comparative analysis of the main parameters of existing cultivators. The most widely used cultivators at a minimum and superficial tillage. Currently, there are a wide variety of cultivators, both domestic and foreign production, which creates certain difficulties in choosing a particular model. The aim of the study is to determine the most suitable cultivators for feeding their crops.

KEYWORDS

Average depth, cultivator, productivity, working speed, working width.

INTRODUCTION

Currently, research is underway in the world to create working bodies and machines that qualitatively perform the process of surface tillage. However, the design and technical

parameters of the cultivators used remain imperfect, do not ensure the fulfilment of agrotechnical requirements for this process. Agriculture is one of the priority areas of the

country's economic development, and food security is one of the main areas of national security. The main task of crop production is to obtain high yields with good grain quality [1, 2]. One of the most important tasks of resource conservation in modern conditions is the preservation of soil fertility since arable land is the main resource in agriculture. Rational soil cultivation is an important link in the system of measures to ensure a high culture of agriculture, increase soil fertility and crop productivity. Tillage is the most important and energy-intensive technological operation in the cultivation of agricultural crops, it consumes up to 40% of all energy consumed in agriculture [3].

Cultivators are most widely used for surface tillage. Currently, there is a wide variety of

cultivators, both domestic and foreign, which creates certain difficulties in choosing a specific model. It follows from the above that the substantiation of the use of cultivators in specific soil and climatic conditions is an important scientific and industrial task.

ANALYSIS

Universal four-row cultivators of the “Слобода” [Sloboda] series.

Cultivators of the “Слобода” series are a flagship product that is not inferior in efficiency to imported analogues and designed using the accumulated domestic and foreign experience in soil cultivation [4].



Figure 1. Universal four-row cultivators of the “Слобода” series.

The units are equipped with press rollers and a harrow (spring) located behind the rollers. The design uses a special arrangement of

working bodies to improve the mixing of soil with plant residues and incorporation of chemicals (Table 1.).

Table 1. Main characteristics of the universal four-row cultivators of the “Слобода” series.

Model	Productivity, ha/h	Working width, m	Working speed, km/h	Depth, cm	Tractor power, hp
«Слобода»	up to 4.8	4	10÷12	3÷15	80÷100

KPS 8, KPSP 4. Cultivators for continuous tillage

Productions of JSC “Agropromtekhnik” (Mikhailovsk, Stavropol Territory) are designed for continuous, pre-sowing soil cultivation and vapour treatment with simultaneous harrowing on different types of soils at a working speed of up to 10 km/h. The cultivators are equipped with a tine harrow section attachment. Provide loosening of the

soil to a depth of 12 cm with the destruction of weeds [5]. Cultivators KPSP 4 and KPS 8 are designed for continuous seedbed preparation and fallow treatment with simultaneous harrowing [6]. The folding frame design of the KPS 8 allows the cultivator to be transported on public roads. The hinged connection of the wings to the central frame of the KPS 8 cultivator improves the copying of the field surface (Fig. 2, 3.).



Figure 2. KPS 8. Cultivators for continuous tillage



Figure 3. KPSP 4. Cultivators for continuous tillage

Trailed cultivator. With the SP-8 hitch, it is possible to create a tractor hydroficated wide-

cut unit from two KPSP 4 cultivators. The hitch is aggregated with tractors with a capacity of 150 hp.

Table 2. Main characteristics of KPS 8, KPSP 4.

Model	Productivity, ha/h	Working width, m	Working speed, km/h	Depth, cm	Tractor power, hp
KPSP 4	up to 4.8	4	12	5÷12	80
KPS 8	6.4÷9.6	8	8÷12	5÷12	150

ANTARES. Modular trailed four-row disc harrows

Four-row disc implements of the ANTARES series with working widths of 3 m, 4 m, 6 m and 8 m make it possible to prepare the background for sowing in one pass using the technology of minimum tillage [7].

and 8 m make it possible to prepare the background for sowing in one pass using the technology of minimum tillage [7].



Figure 4. ANTARES 3x4



Figure 5. ANTARES 4x4



Figure 6. ANTARES 6x4



Figure 7. ANTARES 8x4

Table 3. Main characteristics of ANTARES

Model	Productivity, ha/h	Working width, m	Working speed, km/h	Depth, cm	Tractor power, hp
ANTARES 3x4	3,0	up to 12	до 3,6	160	от 150
ANTARES 4x4	4,0	up to 12	до 4,8	160	от 200
ANTARES 6x4	6,0	up to 12	до 7,2	160	от 300
ANTARES 8x4	8,0	up to 12	до 9,6	160	от 400

Semi-trailed seeding tillage unit “АПП-7,2-02”

Semi-trailed soil cultivating unit “АПП-7,2-02” with flat-cutting tines is designed for the care of fallows, pre-sowing soil preparation, with rippers - for loosening the soil under ploughing, cultivation of old arable lands and fallows [8]. The “АПП-7,2-02” unit can be used

on soils of all agricultural soil and climatic zones, except for soils clogged with stones. The “АПП-7,2-02” unit has a front, middle and side frames, a hitch, transport and support wheels, a hydraulic system for lifting the working bodies out of the soil and transferring

the implement to the transport position and

back.



Figure: 8. Semi-trailed tillage seeding unit APP-7.2-02

On the front and middle cross beams of the frames, flat-cutting shares are installed, on the rear beams - disc levellers. Three hydraulic cylinders are installed on the middle frame, one of which is connected to the transport wheel axle bracket and serves to lift the unit, the other two hydraulic cylinders are connected to the side frames and are designed to fold the unit into the transport position. Double-row rollers with a diameter

of 450 and 240 mm are attached to the frames with rods. The required working depth is achieved by reinstalling the fixing pins in the holes of the brackets above the support wheels and above the rods of the bar rollers. To increase the working depth, the pins are moved to the upper rows of holes. For maximum depth, the pins of the support wheels are rearranged into any holes in the brackets for the beam of the support wheels (Table 4).

Table 4. Main characteristics of “АПП-7.2-02”.

Model	Productivity, ha/h	Working width, m	Working speed, km/h	Depth, cm	Tractor power, hp
АПП-7,2-02	7,34	7,2	10,2	6,5	180

Semi-trailer cultivator “Степняк-5.6” (Stepnyak-5.6).

The “Степняк-5.6” semi-trailer cultivator is designed for a steam treatment, pre-sowing tillage for spring and winter crops, field processing after high-stemmed row crops and grasses, as well as autumn processing of stubble fields (Fig. 9). The “Степняк-5.6” cultivator is designed to work in areas with soils subject to wind erosion [9]. The

cultivator has a prefabricated frame structure and is connected to the tractor by means of a snitch. The frame of the cultivator consists of central and side sections (left and right), connected pivotally by means of axes. Brackets are welded to the frame sections for fixing: working bodies, hydraulic cylinders for lifting side sections, hydraulic cylinder for lifting transport wheels, support wheels and roller beams, as well as combs for adjusting

the depth of processing. The frame of the cultivator and the mill are connected by axes. A bracket is installed on the ladder to adjust its tilt with a lanyard. The pipe of the transport wheel lifting mechanism is attached to the

central section of the cultivator frame. The pipe is welded to the brackets for the installation of the hydraulic cylinder and the central rod, as well as the beams on which the transport wheels are installed.



Fig. 9. Cultivator “Степняк-5.6” (Stepnyak-5.6).

On the rear of the frame are attached to beams, rollers, they are joined by the supporting rollers, pipes which are installed mounting brackets rollers. Support rollers are rod-shaped with a diameter of 400 mm, rolling-plate-shaped with a diameter of 300 mm. The rollers have left and right twists of the bars and plates. Metal support wheels are attached to the front of the frame. The working body of the cultivator consists of a rack and a pointed paw.

To attach the working body to the brackets on the frame of the cultivator, an installation bolt and a shear bolt are used. The paw is attached to the rack with two ploughshare bolts and is designed for pruning and loosening the soil to a given depth of processing. By moving the retainers in the ridges of the support rollers and wheels, the depth of processing is set, and the horizontal position of the frame is set (Tab. 5).

Table 5. Main characteristics of “Степняк-5,6”.

Model	Working speed, km/h	Working width, m	Depth, cm	Productivity, ha/h
“Степняк-5,6”	10,1	5,58	8,5	5,64

RESULTS

Analysing the dependences obtained, the following conclusions can be drawn: the working speeds of all cultivators under consideration are in the same range and differ

insignificantly, the minimum working speed is observed for the “KPSP 8” cultivator (10 km/h), and the maximum working speed of the “Слобода” and “ANTARES 8x4” cultivators (11 km/h).

Table 6. Indicators of technical characteristics of cultivators

Indicators	The value of indicators				
	Pre-sowing tillage				
Cultivator	“Слобода”	“КРСП 8”	“ANTARES 8x4”	“АПП-7,2-02”	“Степняк-5,6”
Recommended tractor power, hp	80-100	150	400	180	165
Operating speed, km/h	11	10	11	10,2	10,1
Working width of capture, m	4	8	8	7,2	5,58
The average depth of processing, cm	9	8,5	16	6,5	8,5
Productivity for 1 h of the main time, ha	4	8	9	7,34	5,64

Working speed of movement, km / h

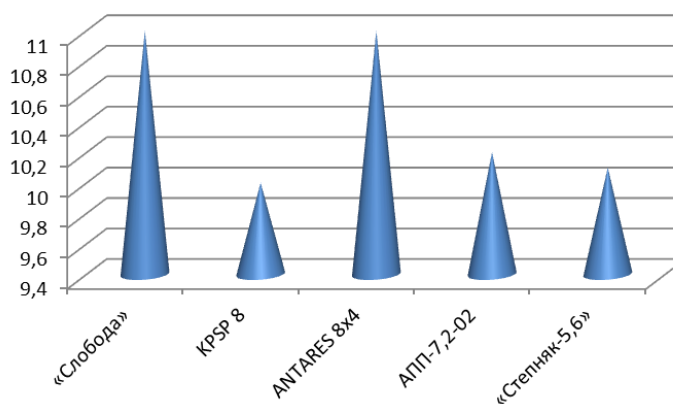


Figure 10. Working speed of cultivators

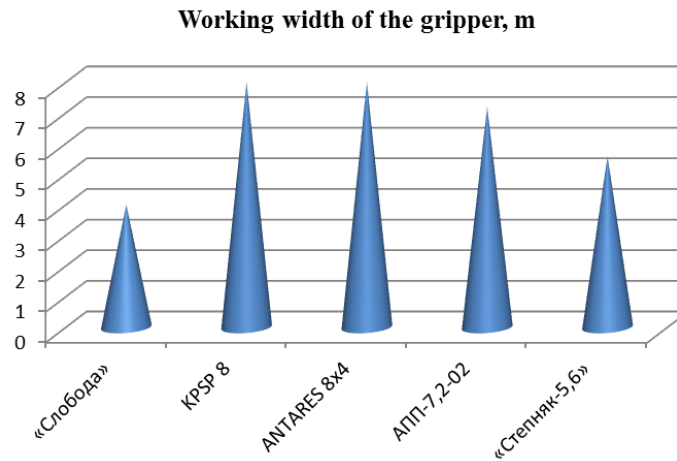


Figure 11. Working width of the harrow

Figure 11 shows that the minimum working width of the “Слобода” cultivator (4 m), and the maximum working width of the “KPSP 8” and “ANTARES 8x4” cultivators (8 m).

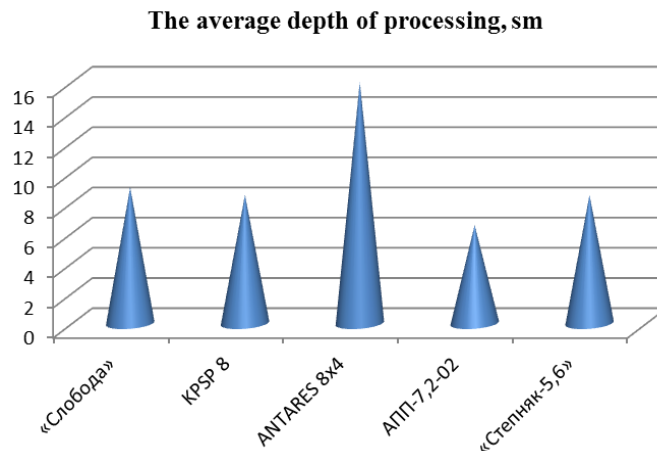


Figure: 12. The average depth of tillage with cultivators

The average tillage depth of all considered cultivators, the minimum average tillage depth for the “АПП -7.2-02” cultivator (6.5 cm), and the maximum average tillage depth of the ANTARES 8x4 (16 cm) cultivator.

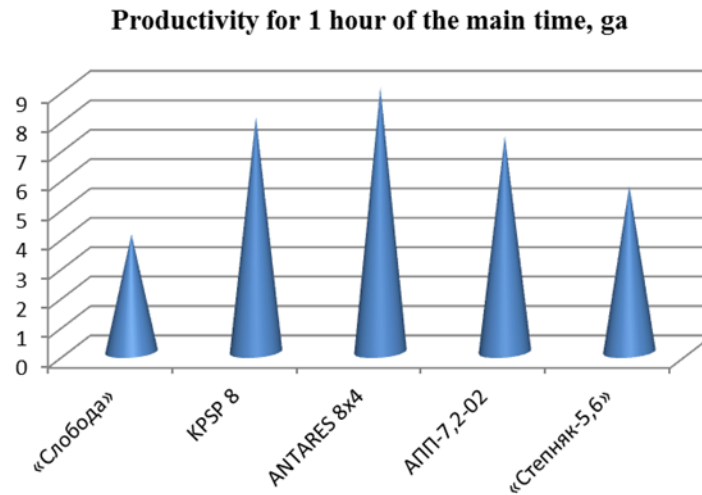


Figure: 13. Performance of cultivators

Figure 13 shows that productivity is lower for the “Слобода” (4 ha/h) cultivator and higher for the “ANTARES 8x4” cultivator (9 ha/h).

CONCLUSION

After analyzing the dependences obtained, the following conclusions can be drawn:

- The productivity of the “Слобода” cultivator is less than 2 times the productivity of the “KPSP 8” cultivator, while the average tillage depth of the “KPSP 8” cultivator is 5.6% less.
- The productivity of the “ANTARES 8x4” cultivator, in comparison with the KPSP 8, is 11.1% higher, while the average tillage depth of the “KPSP 8” cultivator is less by 46.9%.
- The productivity of the “ANTARES 8x4” cultivator, in comparison with the “АПП - 7.2-02” cultivator, is 18.4% higher, while the average tillage depth is 59.4% higher.
- The productivity of the cultivator “АПП - 7.2-02” is higher than the productivity of the cultivator “Стенняк-5.6” by 23.2%, while the average tillage depth of the cultivator “АПП -7.2-02” is less by 23.5%.

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