Conditions and Methods of Research of the Combined Frontal Plug Active Work Body

Sherzodkhuja Mirzakhodjaev[1][a], Uktamkhuja Boboev[2][b], Jonibek Abdunabiev[1][c], Sardorbek Ismonaliyev[1][d] and Jurabek Toshtemirov [1][e]
[1]*Tashkent State Agrarian University, 100140, University str. 2, Tashkent, Uzbekistan*
[2]*FE LLC "UzAutoTRAILER", Samarkand, Uzbekistan*

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Abstract: Article data on the average moisture and hardness of the soil before the tests are carried out. The combined plow with an active working organ developed in field tests 630Cwas added to the Claas ARION tractor, the theoretical and working depth, working speed were determined and the principle of operation was presented. The obtained results show that all the quality parameters of the plow with an active working organ, ie coverage width, processing depth, completeness and depth of burial of plant residues, soil compaction quality and the height of irregularities on the surface of the plow fully meet the agrotechnical requirements. given The developed combined frontal plow with an active working body reliably performed the specified technological process compared to the plow with a passive working body and O'P-4/5-40, and its results are presented. Research of the results reliability of research modern style and measure from tools used without held, combined frontal plug active the work bodies parameters theoretical in terms of in justification higher math, theoretical of mechanics main the rule and methods action done, experiences to the results mathematician statistics methods with processing given, theoretical and practical studies of the results mutually adequacy, done studies based on work developed active the work body the field of tests positive results and to practice current done with explained.

1 INTRODUCTION

In the world, scientific and research work is being carried out aimed at the development of new scientific and technical bases of resource-saving technologies of land plowing and the technical means that implement them. In this direction, among other things, one of the important tasks is to conduct targeted scientific research on the development of a combined plow that plows flat without forming egate and the justification of the technological work processes of its working parts, ensuring energy efficiency during their interaction with the soil. is considered In this regard, it is necessary to develop a highly maneuverable, suspension-combined frontal plug consisting of active and passive working parts (Augambaev et al., 1993; Spirin & Lavrov, 2004; Vedenyapin, 1973; Kobzar, 2006; Johnson & Lyon, 1990; Mirzakhodjaev et al., 2024a; Mirzakhodjaev et al., 2024b; Mirzakhodjaev et al., 2024c; Khudayorov et al., 2023a; Khudayorov et al., 2023b; Khudayorov et al., 2023c; Mirzakhodjaev et al., 2021; Mamatov et al., 2021; Mirzaev et al., 2019; Akhmetov et al., 2024; Akhmetov et al., 2023; Zhanikulov et al., 2022; Saidova et al., 2024; Akhmetov et al., 2021; Irgashev et al., 2021; Obidov et al., 2021; Alimova et al., 2022; Eshpulatov et al., 2021a; Eshpulatov et al., 2021b; Ashirov et al., 2021; Farmonov et al., 2020; Isakova et al., 2024; Astanakulov et al., 2023; Irisov et al., 2023; Irisov et al., 2022; Irisov et al., 2021a; Irisov et

[a] https://orcid.org/0000-0001-8593-1450
[b] https://orcid.org/0000-0001-8593-1450
[c] https://orcid.org/0009-0004-7995-6087
[d] https://orcid.org/0000-0001-8593-1450
[e] https://orcid.org/0000-0001-8593-1450

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al., 2021b; Khaliknazarov et al., 2021; Bokiev et al., 2021; Muhammadiev et al., 2020; Anarbaev et al., 2020; Yunusov et al., 2020; Rakhmonov et al., 2020a; Rakhmonov et al., 2020b; Turdiboyev et al., 2023; Davirov et al., 2020; Djiyanov et al., 2024).

G.N.Sineokov abroad on the creation and use of plugs with active and passive working bodies, the study of their performance and the justification of their parameters, as well as the study of the processes of soil interaction with the active working body, V.I. Medvedev, V.A. Sakun, Ya.P. Lobachevsky, A.P. Akimov, A.I. Vedeneev, M.N. Chatkin, A.F. Juk, V.V. Sharov, V.A.Tumasov, G.Kant, N.V. Bugaychenko, Yu.A. Kuznesov, B.M. Shmelev, L.C. Kaufman, V.K. Klbik, N.G. Kobiashvili, G.F. Popov and others conducted scientific research.

R.I. Baymetov, A. Tokhtakoziev, F.M. Mamatov, I.T. Ergashev, A.A. Akhmetov and others conducted research in this direction in our republic.

Plugs created on the basis of the results of these studies are being used in agricultural production with certain positive results. However, in these studies, the issues of justifying the parameters of the active working body of the combined frontal plug, which provide high work quality with low energy consumption, have not been sufficiently studied.

2 MATERIALS AND METHODS

In order to verify the results of the theoretical studies and to determine the parameters of the combined frontal plug active working body that ensure the required quality of work with low energy consumption, the following were included in the experimental research program:

- development and construction of a laboratory-field device for conducting experimental studies;
- to study the influence of the number, diameter, kinematic mode of operation and processing depth of the blades of the active working organ on the quality indicators and traction resistance of the plug;
- using the method of mathematical planning of experiments, justifying the optimal values of the parameters of the active working body of the combined frontal plug;
- conducting comparative tests of a device with a passive and active working body.

The following agrotechnical parameters of the plow were determined in experimental studies: coverage width, tillage (plowing) depth, level of soil crushing.

To determine the actual coverage width of the plow with an active working organ, the plowed field was divided into 50 m long zones, and wooden stakes were driven every 5 m along a straight line at a distance of 10-15 m from the edge wall of the last pass of the plow. Before and after the passage of the driving unit, the distance from the opposite side of each pile to the egate wall was measured with a tape measure with an accuracy of 0.5 cm. The difference in these dimensions gave the actual coverage width of the plug with the active working organ.

The plowing depth was measured using a special depth gauge. The number of measurements is at least 25 times.

The plane of the plow surface after the driving unit passes yin was determined. On the surface of the plow, perpendicular to the direction of movement of the unit, a special rail with 5 cm sections was installed on wooden pegs driven over the entire width of the plug. The alignment of the rail was checked with a level gauge. Then the distance from the lower edge of the rail to the surface of the plow was measured. Measurements were taken from 21 points at 5 cm intervals and at 3 locations along the length of the plow in one pass of the driving unit.

The plane of the bottom of the plow was determined in the same way as above. Only in this case, the plowed soil in the entire coverage width of the plow with an active working organ was removed and measurements were made.

3 RESULTS AND DISCUSSION

During experimental research, the device was used in conjunction with the Claas ARION 630C tractor of the 3rd class.

During the experiments, the transverse distance between the working bodies was changed from 10 cm to 25 cm with an interval of 5 cm. Each option was conducted at aggregate speeds of 7 and 9 km/h. In addition, when one parameter was changed, other parameters remained constant, i.e. remained unchanged.

A mathematical method of planning experiments was used to optimize the parameters of active working bodies. Experiments were conducted based on a four-factor plan (Akhmetov et al., 2023, Akhmetov et al., 2021).

According to the initial data obtained in the experiments, mathematical statistical methods were used to determine the arithmetic mean values and

mean square deviations of the indicators (Vedenyapin, 1973; Kobzar, 2006; Johnson & Lyon, 1990).

The tests were carried out at speeds of 7.8 and 9 km/h. In this case, the depth of processing with active working bodies was determined to be the same for all options, i.e. 12-14 cm.

The experiments were carried out in the summer months of June-July in the fields of the experimental plot (Fig. 1).

Figure 1: Working process of combined frontal plug with active working body.

Figure 2: Placement of measuring instruments in the tractor cab.

A measuring cylinder was used for determination, and the volume of fuel in it was recorded on a continuous basis.

During the experiments, measuring instruments were placed in the cab of the tractor (Fig. 2).

The lack of possibility to comprehensively take into account in theoretical research the properties of the soil of grain-growing zones, which affect the process of flat plowing, requires extensive laboratory-field experiments.

Table 1: Test conditions.

Indicators, their measurement units	**Values of indicators**
Background (crop planted before the plow)	A field empty of wheat
Soil type	Medium grain
Relief	Flat
Microrelief	Light wavy
Soil moisture (%), in layers	
0-10 cm	9.1
10-20 cm	10.8
20-30 cm	12.5
Average value	10.8
Soil hardness (MPa), in layers	
0-10 cm	3.05
20-20 cm	4.05
20-30 cm	4.98
Average value	4.02
The amount of plant stems in 1 m^2, kg	0.857
Average stem height, cm	9.27

The energy and quality indicators of plugs, including the combined frontal plug, depend on its design parameters (covering width of the body, mutual arrangement of working bodies, size of overlapping between plowshares, location of the active working body and its parameters, etc.) depending on the laws of change and technological and operational parameters (driving depth, driving speed and kinematic working mode of the active working body), the mechanical composition of the soil, moisture, density, microrelief and other properties.

Figure 3 shows the position of the tensioner fingers mounted on the device's shaft and gimbal.

Figure 3: The position of the tension fingers on the device's hinge and cardan.

Accordingly, research was conducted on typical wheat-free fields and the following were considered:

- to determine the quality and energy indicators of the flat working plug with active and passive working body depending on its structural and operational parameters;
- to determine the nature of changes in the quality and energy indicators of the frontal plow depending on the structural and operational parameters of the active working body that processes the surface layer of the soil;
- conducting comparative economic tests of a combined plow with active and passive working organs.

In the course of the research, the following aggregate technical parameters of the working process of the two-body device were determined: coverage width, plowing depth, level of soil crushing, depth and level of burial of plant residues.

4 CONCLUSIONS

Thus, in addition to performing the function of a mover with the help of active working organs, it ensures the improvement of the work quality and energy indicators of the plug in soils with low moisture and high density of the surface layer.

According to experimental studies, in order to ensure the required soil compaction with minimal energy consumption at 22-26 cm working depths of the hulls, the active working body should be installed at a distance of 40 mm forward from the nose of the hull plow and 30 mm to the side of the hull. will be compatible

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