International Journal of Biology and Pharmacy Research Archive

Journal homepage: https://sciresjournals.com/ijbpra/

(REVIEW ARTICLE)

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Improvement of modern machine technologies for the care of cereal crops

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International Journal of Science and Technology Research Archive, 2023, 05(02), 078–084

Publication history: Received on 29 September 2023; revised on 08 November 2023; accepted on 11 November 2023

Article DOI: https://doi.org/10.53771/ijstra.2023.5.2.0089

Abstract

The development of agricultural reclamation is primarily focused on solving the problem of food security by ensuring the sustainable and innovative development of agriculture and the effective assimilation of agricultural soils and natural resources using complex reclamation measures that depend on the introduction of new, resource-saving technologies and technical means of reclamation works.

The most energy-intensive process in the entire technological cycle of caring for grain crops is soil processing, on which 50-60% of fuel is spent on average.

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Raising the care of cereal crops by 30-60% is achieved as a result of the intensification of mechanized work. The use of modern technical means in the restoration and construction of the country's reclamation systems is incredible without knowing their operating indicators, the main characteristics and parameters of the car;

Water resources on the territory of Georgia are unevenly distributed: 1.34 million m3/km2 per year for western Georgia and 0.37 million m3/km2 for Eastern Georgia. Therefore, it is necessary to arrange irrigation systems in the eastern and southern regions of the country, and in the west - drainage systems.

Therefore, the paper proposes two-rotor channel machines imported into Georgia, which allow the withdrawal of open channels to a depth of up to 1.45 m, which is used mainly for drainage and irrigation. The parameters of the working body of the rotary channel plugs, the determination of engine power and the hatching of the base car are calculated.

Keywords: Cereal crops; Open channels; Two-rotor canal digging machines; Technical productivity of the car; Power; Impedance coefficient

1 Introduction

The most energy-intensive process in the entire technological cycle of caring for grain crops is soil processing, on which 50-60% of fuel is spent on average. The first processing of the soil should create favorable conditions for the growth and development of the plant, i.e., it should provide the most favorable heat, water, air, biological and nutritional regimes in the soil for plant development. From this it is clear that for all regions of the republic there cannot be the same soil treatment system and its production requires a differentiated zonal approach. Acceptable natural climatic conditions, terrain, soil type and mechanical composition, amount of precipitation and coherence of its distribution,

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duration of vegetation period, temperature and wind regime, as well as type and alternating of crops in seed rotation are taken into account.

In recent years, the following technologies of soil treatment have been used in world practice: traditional, intense, soil-protective, minimal, zero, mulching, alternating and bazaar. Even in the conditions of Georgia, the optimal technology of soil processing according to the zones should be found in these technologies or in their rational compliance [1].

Consider the peculiarities of these technologies, their advantages and disadvantages:

Traditional technology involves the main processing of the soil with a winged plow, its use is most effective in regions where the annual amount of precipitation exceeds 300-400mm. In addition, plowing with winged plowing is effective for processing the land and the land and the side rats, and for pouring side rates and weeds. It will take its place in another soil treatment system as well. In addition to the fact that the belt is twisted, shredded and mixed during plowing, it is at this time that the ground of the fine colloidal parts of the arable layer is brought to the bottom of the arable layer as a result of rain, and the upper unstructured dusty layer is brought to their place. In such a place, the restoration of the soil structure occurs.

The traditional soil processing technology will still be used for a long time, so plowing technology and plow construction require further perfection. A two-tier plow is more convenient to dig deep into the seeds of weeds and weeds.

In order to eliminate the hardened base of the arable layer and enlarge the development layer of the roots of the plant, the plow construction must ensure both loosening and deepening of the soil.

It should be noted that the 'total~ plowing of the soil we receive in all regions does not contribute to the preservation and improvement of soil fertility, since frequent overflow and loosening of the arable layer leads to its degradation, humus mineralization, and erosion enlarged under the slope conditions.

Intensive technology for caring for heady and safari crops, in addition to traditional bending, involves special processing before sowing the soil so that the surface is fine-grained and well-straightened. Soil treatment with this technology contributes to the equal distribution of seeds of herbicides, pesticides and crops, as well as the absorption of solar radiation. Pre-sowing preparation of the soil is carried out mainly by surface processing machines. In addition, during the vegetation period, it becomes necessary to apply fertilizers, for which such working bodies are needed, which will work during various agrotechnical periods. Such a requirement is more met by active working body soil processing machines.

Intensive soil processing technology deepens the disadvantages of traditional technology, especially in terms of compaction of the lower layer of arable soil. It is estimated that including the increase in transport cargo turnover on the field, 50-80% of the field during the year is covered with the footprint of the hardware suspension system. The depth of soil compaction is reduced to one meter. Therefore, the search for technologies and technical means for soil protection is underway, which ensure not only the reduction of wind and waterborne erosion, but also the effective use of the soil and the restoration of impaired ecological equilibrium [2].

The important thing in soil protection technology is that attention is paid to periodic loosening of the compacted layer. The soil is protected from drying and rinsing by strip treatment of the soil under agricultural crops. For deep loosening of the soil, special reclamation deep baking powders are used.

The technology of minimal soil processing is literally one of the private types of soil protection technology. In turn, minimal soil treatment is a complex of technological operations for the care of agricultural crops, which ensures the reduction of energy, labor and material costs and the reduction of the negative impact on soil fertility and physical properties.

The technology of minimal soil treatment provides for the change of basic processing by cultivating the soil to a small depth; Reducing the number of basic, pre-sowing, inter-order processing by combining weeds with chemical methods; This technology envisages the connection of several technological processes in one work process through the use of combined machines and aggregates: processing only those rows of fields where sowing is carried out without processing the rows.

As we can see, the minimum processing technology holds a great place in the use of fertilizers, and 20-60% of crops fall on them, and 10-30% on soil processing. Therefore, soil littering is increased with both poison chemicals and perennial

weeds. Frequent processing of the surface is accompanied by the hardening of the lower layer of the herd and a decrease in its water and air permeability properties, so it is necessary to combine the processing with the soil with the bristles and discus machines with plowing.

The introduction of minimal soil processing technology requires conducting a number of scientific studies. The study requires the influence of the compatibility of several technological processes on the parameters of the working bodies of combined aggregates, on the basis of which the methodology for calculating the optimal parameters should be processed [3].

A variety of minimal soil treatment is the technology of mulching the soil, which involves the use of leaves and other plant residues for the accumulation and storage of moisture, and during torrential rains, the soil is protected from washing away and excessive moisture. It reduces the depth of soil freezing in winter and protects against overheating during the hot summer heat, promotes the formation of a dense fine structure of the soil and protects it from crushing, all this increases the yield of agricultural crops. Despite the fact that agronomic scientists have carried out a lot of work in this direction in the Republic, mulching technology has not been widely spread in Georgia due to the lack of appropriate technical means.

During soil processing ~zero~ technology, only 25% of crops are processed, and weeds are sprayed using chemical methods. The use of large doses of herbicides leads to rotting of the soil, and some weeds adapt to exposure to the herbicide.

In the conditions of rising prices of fertilizers, herbicides, pesticides and other chemical means, the non-herbicide technology for growing and growing agricultural crops is especially important. It not only eliminates the use of fertilizers and pesticides, but also involves the creation of conditions under which they will not be necessary. It is known that 25.5% of the total energy expenditure in traditional farming comes from the production of fertilizers and pesticides. In herbicide technology, these costs are excluded, but the yield decreases 9-36%, and labor costs increase by 25-35%. In order not to reduce the yield, in addition to magnifying the use of organic fertilizers, the production of legumes crops should be expanded by 30-40%, if it is possible to change the sowing area in such proportion. In such technology, mechanical methods of combating weeds are of great importance. The destruction of weeds begins immediately after harvesting.

Under the conditions of Georgia, potato, corn, legumes and vegetable crops are partly already grown on bases and rocks, i.e., with the technology of bathing and tracing. This is especially convenient for both over-damp and irrigation zones.

An important point is that soil fertility is considered not as a gift of nature, but as a means of production, so no technology or technical means of its processing, no matter how much energy and crop yield, it will not be considered an achievement unless it is ensured by the expanded fertility of the crop. This formula applies not only to the soil, but also to other agricultural environments. Therefore, the demand for expanded agrophone production is highlighted in the priority direction of mechanization development [4].

Considering what soil processing and grain crops care for the currently accepted machine technologies, it is noted that 30-60% of crop growth is achieved as a result of the intensification of mechanized works, although soil pollination and hardening reduce this effect by 10-20%, so the search for an optimal solution to the problem becomes intense soil-protective as if incompatible. By combining the positive properties of technology. This allows for the execution of several technological processes with combined working bodies (when such a junction with agrotechnics is allowed) and the use of wide-ranging aggregates when the aggregate suspension wheels are moved to a permanent technological footprint.

According to natural and climatic conditions, the territory of Georgia is specific. This explains the different nature of agriculture and the need to carry out appropriate melioration measures is obvious.

The use of modern technical means in the restoration and construction of the country's reclamation systems is incredible without knowing their operating indicators, the main characteristics and parameters of the car; The example below shows the principle by which a melioration vehicle can be selected according to the given parameters of the reclamation object.

Open channels can be pulled with a rotating working organ channel, through which a clean slope and straight bottom channels are produced. During the digging of the canal, the ground is thrown on both banks of the channel. The main working organ of this type of feeders is rotors and frets of various shapes. Ground cutting is produced in the perpendicular plane of the rotor or freezy torque axis. The ground cutting speed is up to 30 m/s, and the rotational

speed does not exceed 8 m/s. The shape and dimensions of the channel depend on the size and shape of the rotating working bodies, the number of rotors, the angle of setup. Fig. On 1 are the main parameters of the open channel.

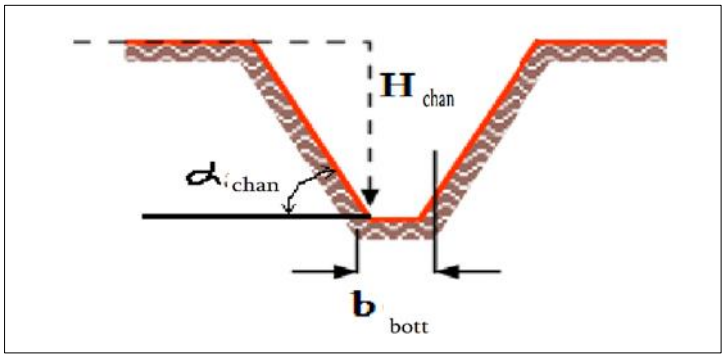

Figure 1 Basic parameters of the open channel

H_{chan} – Channel depth (m); b_{bott} - the width of the bottom of the channel (m); φ_{chan} - the angle made by the slope of the channel to the horizon;

Two-rotor canal digging machines have been imported into Georgia, with the help of which open canals are made at a depth of up to 1.45 m (Fig. 2);

Figure 2 Two-rotor channelizer

Open channel plug machines are mainly used for drainage and irrigation. The two rotors receive rotational movement from the tractor power capture shaft through the cardan transmission and reducer, the rotors torque the cutting of the ground and its equal scattering in the adjacent lane on both sides of the channel [2].

When reporting the rotary channel, the parameters of the working body are primarily conducted, the determination of engine power and the squeezing of the base car.

The main parameters of the rotary channel plug machines include: rotor diameter, width, rotor circuit speed, working speed of movement of the car, ground cutter and number of cut ground scattering elements.

The rotor diameter of the rotor of the two-rotor channel plug is determined by the following formula:

$$d_{rot} = \frac{4\left(H_{chan} + \sqrt{\frac{k_{loos} S_{chan}}{2ctg\varphi_{gr}}}\right) - \frac{H_{chan}}{0.5} sin\, a_{chan}}{3 \sin a_{chan}} \quad \ldots\ldots\ldots\ldots (1)$$

Where

H_{chan} is the depth of the channel (m);
k_{loos} - Ground loosening coefficient;
φ_{gr} - natural tilt angle of the ruin ground;
a_{chan} - Angle drawn by the channel slope to the horizon;
S_{chan} - The area of the transverse channel section, m^2, the meaning of which is determined by the formula

$$S_{chan} = H_{chan}(ctg a_{chan} H_{chan} + b_{bott}) \text{ ..... (2)}$$

Where b_{bott} - The width of the bottom of the channel is (m).

The diameter of the rotor without the height of the teeth d_0 is selected from the following dependencies

$$\frac{H_{chan}}{d_0} = 0.45 \div 0.5$$

The width of the rotor is determined by the formula

$$b_r = \frac{\Pi_{\text{tech}}}{3.6 \cdot 10^3 (d_r^2 - d_0^2)\frac{\pi}{4} n_r k_r i_r} \text{ ..... (3)}$$

Where
Π_{tech} is the technical productivity of the car (m^3/h);
k_r _ coefficient of filling the rotor workspace, k_r=0,52 ÷ 0,55
n_r _ number of revolutions of the rotor (revol/min); Its value is determined

$$n_r = \frac{V_{cir}}{\pi \cdot d_r} \text{ ..... (4)}$$

The circular speed of rotation of the rotor (m/s) is determined by the formula

$$V_{\text{cir.}} = \sqrt{X \cdot r_{\text{rot.}} \cdot g} \text{ ..... (5)}$$

Where
X is the reporting coefficient (0.4 ÷ 0.8);
$\boldsymbol{r_{rot.}}$ - rotor radius (m);

g - acceleration of free fall (m/s^2);

The working speed of the trencher is determined by the formula

$$V_{\text{work}} = \frac{\Pi_{\text{tech}}}{3.6 \cdot 10^3 S_{chan}} \text{ ..... (6)}$$

Determination of engine power and selection of base car:

The total lifting power (kW) of all types of rotary machines is determined by the formula

$$N = N_{\text{pow}} + N_{\text{move}} + N_{add} \text{ ..... (7)}$$

Where
N_{pow} is the power required to lift the rotor;
N_{move} - the power required to move the car;
N_{add} - power required for lifting additional mechanisms and nodes;

The power required to lift the rotor is determined by the formula

$$N_{\text{pow}} = \frac{N_{\text{dig}} + N_{rot} + N_{fric} + N_{\text{lift}}}{\eta_{amb}\eta_r} \text{ ..... (8)}$$

Where N_{dig}, N_{rot} , N_{fric}, N_{lift} Accordingly, there are significant capacities for digging the ground, rotating the cut ground to the circular speed of the rotor, overcoming friction and lifting the cut ground;

η_{amb} is a worker organ amber (MCK), ($\eta_{amb} = (0.75 \div 0.85)$);

η_r - rotor (MCK), ($\eta_r = 0.7 \div 0.8$).

The digging capacity of the ground, when the thickness of the beam is more than 0.03 m, is determined

$$N_{digg} = \frac{k_1 \Pi_{\text{tech}}}{3.6 \cdot 10^3} \text{ ..... (9)}$$

Where k_1 is the ground-digging caudal impedance coefficient, Kpa;

The power required to drive the cut ground rotor to circular speed is determined

$$N_{\text{driv}} = \frac{\Pi_{\text{tech}} \rho V_{\text{circ}}^2}{7.2 \cdot 10^6} \text{ ..... (10)}$$

Where ρ is ground density, kg/m^3;

Power required to overcome friction in the case of a two-rotor trencher

The power required for lifting the cut ground is determined $N_{frict} = 0$

$$N_{\text{lif}} = \frac{\Pi_{\text{tech}} \cdot \gamma \cdot h_{\text{aver}}}{3.6 \cdot 10^3} \text{ ..... (11)}$$

Where
γ is a ground couture weight, n/m3;
h_{aver}- average ground lifting height (m);

The power included in the formula is the work required the condition is determined for the movement of the car

$$N_{mov} = \frac{FV_{\text{mov}}}{10^3 \eta} \text{ ..... (12)}$$

F - total traction resistance force, n;

η –MCC of the base car's undercarriage mechanisms (η=0.7÷ 0.8);

The power required for lifting additional mechanisms and nodes is determined by the formula

$$N_{\text{add}=} 0.05 \div 0.07 (N_{\text{pow}} + N_{\text{mov}}) \text{ ..... (13)}$$

Checking the engine power of the base car is produced by the following formula

$$k_{\text{eng}} = \frac{N_{eng}}{N_{pow}} = 1.2 - 1.4 \text{ ..... (14)}$$

The main operational indicators of the two-rotor trencher are given in Table 1;

Table 1 Performance indicators of the two-rotor trencher

№	Naming indicators	Units of measurement	parameter values
1	diameter of the rotor	M	1.45
2	Channel cross-sectional area	m^2	0.3
3	rotor width	M	0.25
4	Circular speed of rotation of the rotor	m/sec	2.2
5	Working speed of movement	m/sec	0.3
6	total capacity	kW	42

2 Conclusion

The basis for increasing the yield of agricultural grain crops is considered to be the improvement of new machine technologies, the exlution of technological machines is considered to be one of the main determinants of the self-value of plant products. The issues of the maintenance and cultivation of the crops discussed depend on the machinery technologies, as well as the implementation of agro-time and the correct determination of the parameters of the flea regime taking into account the characteristics of soil and soil and natural and climatic factors.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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