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INVESTIGATIONS CARRIED OUT ON DETERMINTION OF THE SIZES OF AGGREGATE WORKING ORGAN WHICH PROCESSES THE SOIL BLOCK WITHOUT CUTTING IT COMPLETELY

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Annotation
This article is focused on the analysis results on the methods of defining the sizes of the aggregate working organ which processes the soil without cutting it completely. This article highlights the references on the methods of determining the resistance of plow working organs, depth of processing and the moisture and hardness of the processed field soil, plant remnants and the height of weeds, amount of weeds, depth of plugging. Due to the results of comparative experiments of plow corps of different types, POT 01.000 corps is recommended for the plow aimed for general works.

Keywords. Soil, block, processing without cutting completely, aggregate working organ, method, plow, resistance, depth of processing, humidity, hardness, plant remnants, depth of digging, plow corps, experiment results.

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Introduction

Basic processing and processing before sowing in agriculture production are the processes requiring the most energy. 40-50% of the total energy required for germination of cotton, grain and other agricultural products are spent for accomplishing these processes. It shows that achieving the decrease of energy expenses in basic processing and processing before sowing are very important scientific-technical issues and its favorable solution gives an opportunity to economize fuel materials in our Republic, decreasing labor and financial expenses, increasing the labor efficiency and endurance of a machine and a tool, decreasing the metal expenses noticeably for their production. All of these will eventually result in the decrease of the costprice of the germinated agricultural products and further development of other branches of producing cotton, grain and agricultural products.

The results and practice of perennial scientific investigations show that in order to gain high harvest from agricultural products basic processing of the soil, i.e. plugging the soil is considered to be important. If these agro technical measures are taken in time and qualitatively, convenient conditions for the decrease of the moisture in the soil, growth of the weeds in the fields, qualitative sowing of the seeds of agricultural products, growing them qualitatively and developing the baby plants will be created.

In order to supply basic processing of the soil, O'P-4/5-40 plow is being produced in our Republic. The main demand put before processing the soil with this plow is to provide complete and deep digging of plant remnants by spending little energy and to plug the soil qualitatively. This kind of quality indices of plugging depend on developing technologic process and the construction of machines processing the soil and the working organs multilaterally. [1]

Principal scheme of the plow is shown in Picture 1. It consists of hanging mechanism-1, Mechanism of setting the width of the first corps- 2, fixer for hanging the direction of the pulling line- 3, frame- 4, corps- 5, basic wheel- 6.

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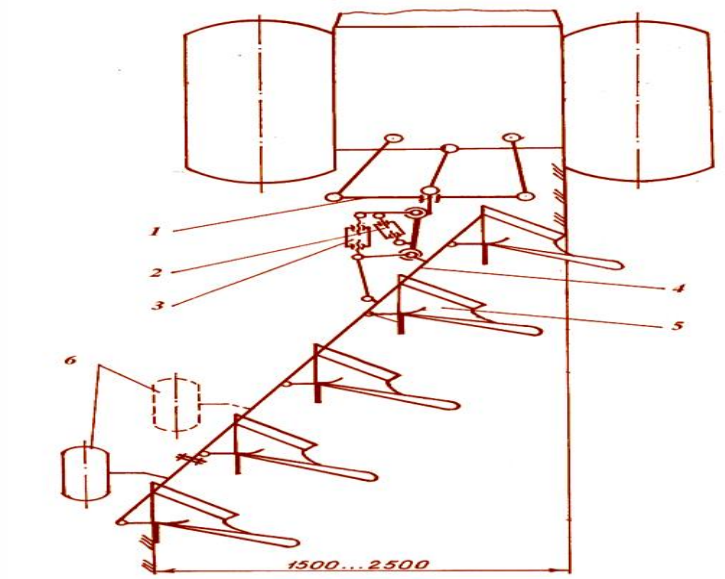
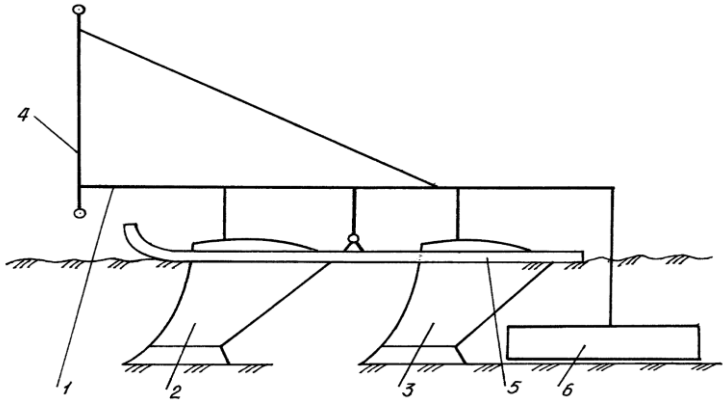


1- hanging mechanism; 2- mechanism of setting the width of the first corps; 3-fixer for changing the direction of the pulling line; 4- frame;
5- plow corps; 6- basic wheel.

Picture 1. General view of the plow aimed for general work applied with "Magnum" tractor

Investigation results carried on choosing the methods of defining the plow parameters and the plow corps are given.

Investigation methods. Investigations were carried out by applying field dina mometer device. Its constructive scheme was shown in scheme 2. It consists of a frame 1, corps 2 (not measured with dynamometry) and 3 (measured with dynamometry), hanging mechanism 4, basic wheel 5 and landside 6.



Picture 2. Scheme of dynamometric field device

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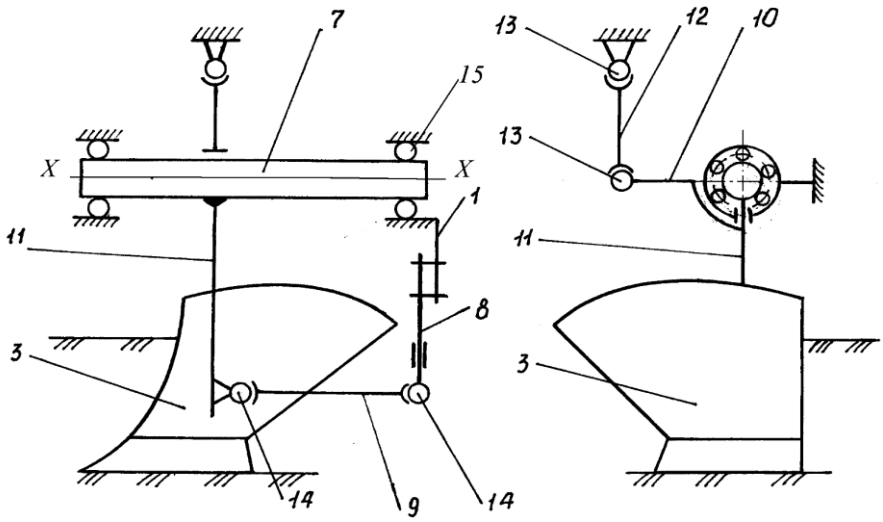
Dynamometric corps- 3(picture 3) was fixed to the frame by dynamometric plough-beam- 7 settled in sliding bases. It is tied with a strain gauge 8 by the link- 9 which I straightened by length. [2] This plough beam is protected from turning round the arrow X-X by the handle 12 and spherical bearing 13 with the frame 1 and held by the hinge and corps column 11 to which the handle 10 is fixed toughly. The same spherical bearings- 14 are fixed at the end of the link- 9.



Picture 3. Dynamometric corps of the device

The strain gauge 8 is made from normalized steel 40X and has a rectangular form with the surface of horizontal cut of 80x30 mm. Two strain ages of 2ПКБ 20-200 type which have the base of 20 mm and the resistance of 200 Om are glued to the strain gauge by the scheme of half bridge. Hub bearing 7 is fixed to the frame 1 at the spherical base 15, it gives the opportunity to move by the arrow X-X and to turn around. The links 9 and 12 protect it from the movements. [3]

In order to adapt the setting corner of ploughshare to the bed wall the columns of bodies should have round cut and be prepared without landsides. Instead of the woods one general landside- 6 of he back side of the second corps is set (Picture 3). The device construction provides the equal parallel movement of the landside in a horizontal direction. [4] By this we can achieve to make the device work not leaning laterally and not to change working width of the dynometric corps.

In order to increase the balance of device movement in a horizontal flatlands the lower apex of the landside must be sharpened and the ploughshares of bodies must be 10 mm lower than the level of knives. [5] Plugging depth makes the sliding base- 5 up and down

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by a fixer. Sliding base was set on its column with its hinge, along with it the arrow of hinge is set opposite the front side of dynamometric corps, this eliminates the influence of corner oscillation dynamometric corps in a horizontal-vertical flatlands on the plugging depth. Sliding base slides along unplugged field surface during the period of plugging. The length of the plain base part of the sliding base is 2.1 m, its width is 30 cm; it provides balanced movement of the device along the depth in the fields with unplain land. [6]

Before carrying out the experiments we determined the speed of plugging aggregate and set the necessary plugging depth, due to general background, soil moisture and hardness, the height and thickness of plant remnants, their mass were determined in 0…10, 10...20, 20...30 and 30...40 cm of soil layers, the squares of 50 m length were noted for calculations.

Soil moisture was determined by the method of drying the taken samples under 105 temperature in a cupboard during the time not less than 5 hours. The repetition of determining the moisture for each layer was 6 times.

Hardness of soil was determined by the hardness measuring tool ВИСХОМ in places where the moisture was defined. Here a cone shaped apex with 22°30′ of apex corner and the base diameter with 11.3 mm (S=1cm^2) was used. The repetition was 6 times. [7]

The height of plant (root) remnants and weeds was determined by a measuring rule. Incorrectness of measurement is equal to ±1 cm. The number of measurements in each square is 50. [8] The indices were taken measuring from the soil surface up to the highest point of a plant remnant.

Amount of root remnants (its thickness) were determined by the plant remnants in calculating squares having 1 m^2 square. The mass of plant remnants were determined on the same squares too. The remnants of the gathered plants were measured with ±10 g of accuracy. [9] The repetition is 6 times. Before carrying out the experiment the humidity and hardness of square soils and the cover with plant remnants were identified.

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Plugging depth was determined by measuring the depth measurement along the bed formed with dynamometric corps after each pass of the aggregate of the considering experimental field. The device was measured 50 times after each pass. Incorrectness of measurement is equal to ±1 cm.

Plant remnants and completeness of digging the weeds were identified by the mass of plant remnants and weeds left by not digging them. [10] Calculations of the remnants of the plants left not being dug and the weeds were made in the squares with 5 m long and the width equal to the width of the device. The remnants of the plants not being dug were gathered and weighed on the scales with ±10 g incorrectness. One sample was taken from each calculating experimental field.

Calculations were accomplished by the following formula

$$П_з = \frac{m_1 - m_2}{m_1} \cdot 100, \%$$

Here, $П_з$ – are digging completeness of the plant remnants and weeds;

m_1 – is the mass of plant remnants brought to the experimental field calculated before the device work;

m_2 – is the mass of plant remnants after the device work.

The depth of digging plant remnants and weeds and the leaning corner of the block were determined by the method of measuring from the upper and lower edges of plant remnants in the width by cutting the field vertically. There were 2 straight cuts in every experimental field. The measurements were carried with ±1.0 cm accuracy by a scale ruler. [11]

Entrance of the plough was determined in a square with 400 m length. It was registered when the entrance had a constant character i.e. when it entered the soil without soil clots. When it had soil clots stuck, plugging was stopped and cleaned from the mass and plugging was continued. Plough stuck was evaluated by the amount of soil stuck.

We determined the quality of soil grinding in six times in every version of the experiment (3 in aggregate moving and 3 in aggregate returning). [12] In order to determine the soil grinding, the soil sample in 0.25 m^2 square was taken by the help of box without a bottom (the size of which is 0.5x0.5 m). The gained samples were separated to the fractions with such sizes as larger than 100 mm, 100...50 mm and less

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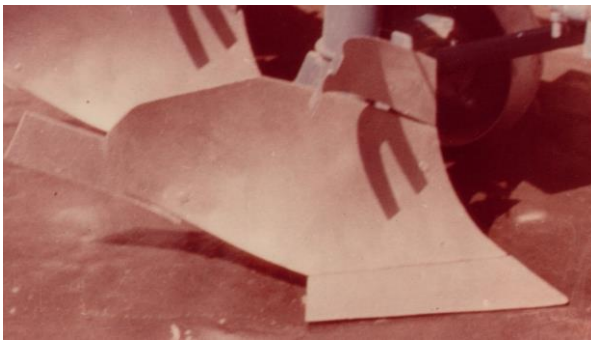
than 0 mm. Separating the gained samples into fractions was accomplished by the help of 100 and 50 mm plain strainer in the same field. [13] Along with this, short soil clots were gathered by hand, and then the soil was sieved as above mentioned. All fractions were measured in scales and the relativity of the sample of gained soil to the general mass was calculated in percentage.

By agro technical requirements the fractions less than 50 mm were considered to be favorable. [14] Therefore, the relativity of the sample of soil fractions with less than 50 mm size (diameter) to the general mass was received as the degree of soil grinding.

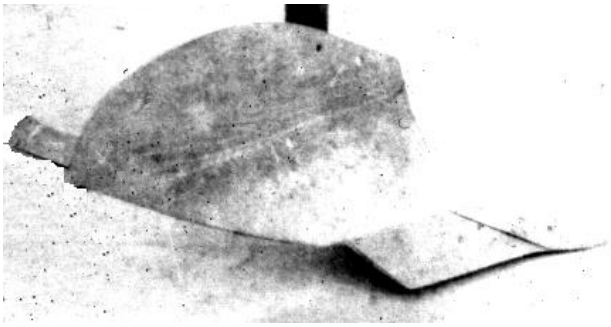
The references gained from experimental investigations were worked out by mathematical methods of statistics on a computer.

Investigation results. In order to carry out experimental investigations different corps were prepared. (pictures 4,5,6).

Picture 4. ПОТ 01.000 corps



Picture 5. ПОМ 01.000 corps



Picture 6. К30R corps

In order to choose a corps type, the comparative experiments of the corps of ПОТ 01.000, ПОМ 01.000 and К30R (by “Lemken” firm) type were carried out.

ПОТ 01.000 corps(picture 4) has a half screw form. Its working width is 40 cm. It is composed of a full shoe, plow share, chisel set with the beak of plow share, wrapper and

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landside. [15] A corner knife is set in the upper part of the wrapper. This corps is set on the plough ПОН-3-45.

ПОМ 01.000 half screw (rapid) corps (picture 5) Its working width is 40cm. it consists of a shoe prepared by welding, the trapezoid ploughshare fixed to it, chisel, wrapper and landside. On the upper part of the wrapper, there is a knife set on the corps and a blade feather is set on the wing of the tailpiece. This corps is set on ПОН-4-40 plow.

K30R is a half screw shaped corps too (picture 6). Its working width is 40 cm. It consists of a shoe prepared by welding, a ploughshare fixed to it, chisel, wrapper and landside. A corner knife is set on the upper part of the mould board shin and a blade feather is set on the wing of the tailpiece. This corps is set on the plow of "Vari-Europal" of Lemken firm. All the experimented corps are aimed to plug up to 35 cm depth.

While carrying out the experiment the processing depth of the device was marked as 35 cm, the motional speed of the aggregate was marked as 8 km/hour.

In order to make equal influence on the gained results, we made the working width of all corps as 40 cm.

The experiment results are given in the following table.

Results of comparative experiments of different plough types aimed for general field works

Name of the indices	ПОТ 01.000	ПОМ 01.000	К 30 R
Motion speed, km/hour	7.8	7.9	7.8
Plugging depth, cm			
M_{cp}	34.8	34.9	34.3
$\pm\sigma$	1.9	2.8	2.4
Working width, cm	40	40	40
Depth of digging the plant remnants, cm			
M_{cp}	17.6	12.7	13.5
$\pm\sigma$	4.1	5.9	6.0
Complete digging the plant remnants, %	96.1	81.4	84.1
Quality of soil grinding, %			
Fraction sizes, mm			
Larger than 100	8.9	10.2	9.4
100...50	12.0	11.3	13.4
Less than 50	79.1	78.5	76.3
Resistance to pulling, kH	10.18	11.53	10.68
Comparative resistance, kПа	73.13	82.62	77.87

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As it is seen from the references given in the table, the results of ПОТ 01.000 corps showed the highest results by the main working indices among the compared corps.
In the experiments, the depth of processing of all corps had almost the same value (34,3...34,9 cm), suiting the marked depth shows that they work by the depth constantly. Along with this deep and full digging of plant remnants of ПОТ 01.000 corps relatively higher to 4…5 cm and 12…15 % than ПОМ 01.000 and K30R corps and it suits the current agro technical measures, the comparative resistance was 6…13% less respectively.
During the experiment due to the fact that soil moisture was in a favorable condition, all of the experimented corps had the required indices by the quality of soil grinding.
Resulting from the above mentioned, the ПОТ 01.000 corps was recommended for the plow aimed for general works.

Conclusion

1.The perennial experiments carried out for several years show that in order to achieve high harvest from agricultural products it is important to make basic processing to the soil i.e. plugging the soil qualitatively and if this agro technical measure is carried in time and qualitatively, convenient conditions would be created for preserving much moist in the soil, decreasing the growth of weeds in the fields, sowing the seeds of agricultural products qualitatively, making them bud fully and developing the baby plants well.
2. A number of experiments were carried out on choosing the type of plow corps by using the methods of determining the resistance of working organs of plows, the depth of processing and the moist of the processed field soil, the height of plant remnants and weeds and the depth of their digging; the gained results were analyzed.
3. Due to the experimental investigation results, it was determined that ПОТ 01.000 corps meets the agro technical requirements and they were accepted for further investigations.

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