ТЕХНІЧНІ НАУКИ

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FIELD TESTS OF THE EXPERIMENTAL INSTALLATION FOR SOIL PROCESSING

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It is experimentally established that the quality of soil grinding by the experimental ripper-separator is especially affected by the humidity and density of the composition, so at a soil density of 1.3–1.4 g/cm3 and a minimum soil moisture of 11.4–14.4% rotor speed must be increased up to 127 rpm.

Keywords: *tillage, cultivation, soil layer, rotor, differentiation.*

Introduction. Differentiation of the cultivated soil layer according to the structural composition in which agronomic valuable lumps ranging in size from 5 to 20 mm – 20-25%, from 0.25 to 5.0 mm – 60–65% and not more than 15% of lumps less than 0.25 mm, provides plants with nutrients and moisture. It is carried out by deep surface processing in the fall and mulched processing to the depth of sowing in the spring. In this case, lumps from 5 to 20 mm in size prevail in the surface soil layer, and from 0.25 to 10 mm in the seed embedding zone (Fig. 1) [1].

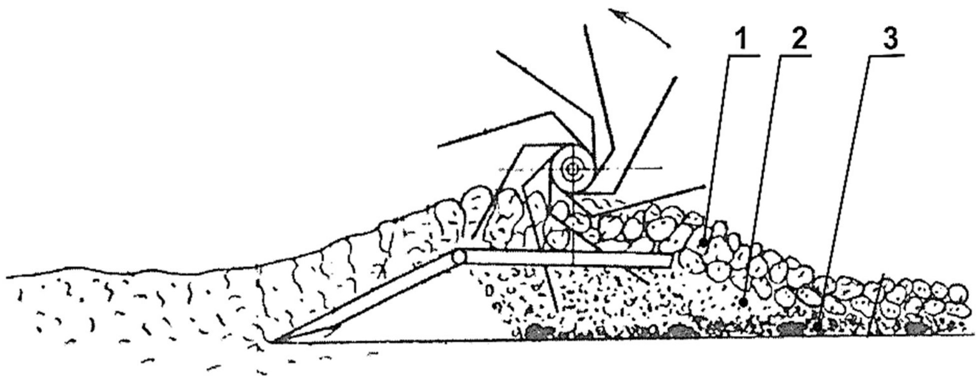

Fig.1. **The structure of the processed layer:** 1 – above the seed layer (lumps size from 5 mm to 20 mm); 2 – seed layer (lumps size from 5 mm to 20 mm); 3 – seed embedding zone (lumps size from 0.25 mm to 10 mm)

There is a machine for optimizing the agro physical properties of the arable soil layer [2-4].The use of an active working body (rotor) [5] allows for a single pass of the unit to ensure high quality tillage. However, the action of the rotor knives on the soil layer fed to the separating grid has a ambiguous effect on the getting of agronomic valuable aggregates depending on the rotational speeds of rotor, moisture and soil density. To a certain extent, even the minimum rotor speed is sufficient to optimize soil crumbling. Determination of indicators of crumbling of the seed soil layer depending on the rotor speed at various initial parameters of moisture and soil density will improve the quality of grinding the soil layer.

Analysis of research and publications. In precision farming systems, modern soil cultivation methods are based on layer processing both in width and depth [6, 7]. Differentiation of the cultivated soil layer according to the structural composition using the technological operations of its processing, increases the stability of the system in unstable climatic conditions. An example is various technologies based on strip tillage [8-10]. For these purposes, complex aggregate are used that perform a number of technological operations. Existing technologies are based on the fact that seeds should be in contact with soil with high capillary conductivity [11-13]. During this period, looser soil composition is desirable, which provides better absorption of moisture of precipitation, especially at their high intensity. The task of preparing the soil for sowing is to create optimal conditions for seedling, which is provided by cultivating the soil to a depth of seed placement. Direct sowing is not excluded in the presence of appropriate machines [14].

The effectiveness of soil cultivation using cultivating-separating active working bodies was studied in one stationary field experiment, 6 field experiments and 8 vegetation-field (model micro field) experiments. The effective fertility of individual soil layers was studied in four model micro field experiments. The feedback of crops on the cultivation of soil layers was studied on models where superposition of various combinations of layers of 0-10, 10-20 cm was used. The study of changes in the effective fertility of the soil from mixing or moving of its parts (loosening, turnover) artificially imitate methods of soil cultivation against the background various fertilizers, which were studied in two micro field experiments. It was found that the differentiation of the arable layer by fertility occurs both on good and on medium cultivated soil. The difference with respect to the effective fertility of the soil layers is 10 – 20 cm less than that of the 0 – 10 cm layer. With depth in the soil, the content of humus, basic nutrients, the total duty cycle, and the duty cycle of aeration decrease, but the agronomic content of valuable aggregates and their resistance to moisture absorption, equilibrium density of stow and soil hardness [15-17].

It was established that careful loosening of the top ten centimeter layer of soil in the spring provided an increase in crop yields compared with mixing or turnover. At a processing depth of 0 – 10 cm, loosening compared to turnover increased yield by 16%. Mixing the soil with a depth of 30 cm reduced the productivity of plants compared with the option of loosening and increased compared with the option where a full revolution was carried out.

Research V. V. Medvedev established the basic agro physical properties and regimes that determine the fertility of chernozem soils, revealed the relationships between them, fertility models developed for some cultures and ways to optimize them [18-21].

However, the technical capabilities of means of mechanization, taking into account the heterogeneity of the fields and the characteristics of plants in precision farming systems, are still insufficient. They are limited only by the introduction of fertilizers and plant protection products [22, 23, 24, 25]. A significant reserve for realizing the advantages of precision farming is mechanical tillage, which, provided there are appropriate tools, makes it possible, on the one hand, to process it taking into account its physical properties, and, on the other hand, to create the necessary parameters of these properties in accordance with agricultural requirements [26-28]. The key to managing these properties of the arable (sowing) layer is to regulate the structural composition and density of the soil structure. Moreover, it is important to at least reduce the difference between the real and optimal parameters of these properties before sowing. The differentiation of the cultivated soil layer according to the structural composition is the reason for a very high (up to 2-3 times) variation in yield. Moreover, it is believed that the structure of the soil cover is a difficult to regulate factor and affects the efficiency of fertility management [29, 30].

The statement of objectives of the article. Determine the indicators of crumbling of the sowing layer of the soil depending on the rotational speed of the rotor of the tillage installation at various initial parameters of moisture and density of the soil structure.

Material and methods

The small-lumpy structure of the soil in the seed embedding zone is ensured by the redistribution of particles along the depth of the seed layer, which eliminates the need to crumbling the soil intensively. For carrying out experiments in the field, the installation was made that stratifies the soil by separating lumps according to the depth of processing [31-33]. The unit was aggregated with a general-purpose agricultural tractor T-150K-08 [34]. It is a rigid frame with a hitch. On both sides of the frame are metal support wheels with mechanisms for adjusting the depth of tillage. At the rear of the frame is a four-part rotor. The rotor is driven from the tractor power take-off shaft, which is tuned to a rotation speed of 540 rpm. In this case, the rotor speed is changed using a two-stage gearbox and by adjusting the engine speed in the range from 1000 to 2100 rpm.

The rotor is a pipe onto which separator knives are welded in increments of 50 mm (Fig. 2).

Fig.2. **The rotor of an experimental tillage installation**

The location of the knives on the rotor shaft affects the change in drive torque and speed.

In this case, the knives are placed on the shaft along a helix with the number of connection equal to the number of knives on the shaft, and the beginning of the first helix should coincide in the opposite part of the shaft with the end of the second helix, etc. In addition, the knives must be placed evenly around the entire circumference of the shaft with an angular distance between adjacent knives

$$\alpha_z = \frac{360^0}{2n} \quad (1)$$

where n - is the number of knives.

An example of the arrangement of 18 rigidly fixed in pairs knives symmetrically to the longitudinal axis is shown in fig. 3.

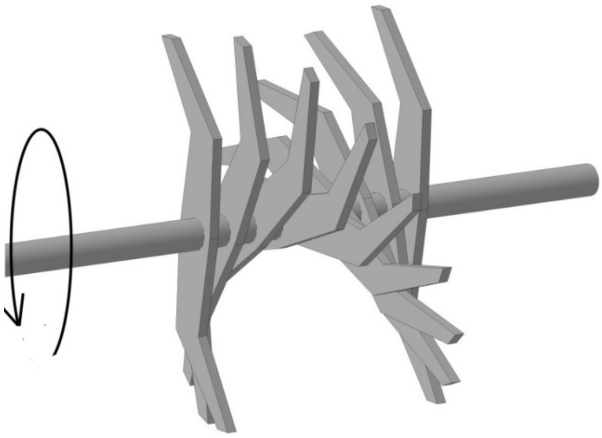

Fig.3. **The rotor of the tillage cultivating-separating machine with 18 knives fixed in pairs symmetrically to the longitudinal axis**

In the table 1 shows the angle of shear between adjacent knives αz depending on the number of knivesinstalled on the shaft and their sequence of entry into operation.

Table 1

The sequence of entry into operation of the knives and the angle of shift between them

The number of rotor knives 2n	The angle of shift between adjacent knives α_z	The sequence of entry into operation of the knives
5	35° 0′	1 – 4 – 2 – 5 – 3
7	25° 42′	1 – 5 – 2 – 6 – 3 – 7 – 4
8	33° 45′	1 – 4 – 7 – 2 – 5 – 8 – 3 – 6
9	20° 0′	1 – 6 – 2 – 7 – 3 – 8 – 4 – 9 – 5

The above shows that a certain number of knives corresponds to a well-defined angle of shear and the sequence of entry into operation.

Obviously, reducing or adding knives without changing the arrangement can lead to poor stability of the machine and an increase in the unevenness of torque.

In the front of the frame are cutting-lifting working bodies [32, 35]. They are a flat cutter paw with a crumbling angle of 15° with curved ends of the wings. The wings are welded towards a chisel. To the wing with a flat cutter paw, bars of the separating lattice are welded in such a way that the rotor separator knives enter between the bars of the separating lattice.

The working length of the separating grate is selected from the conditions for obtaining the guaranteed thickness of the finely lumpy soil layer covering the seeds. The thickness of the soil layer sifted through the gaps of the separating lattice is determined by the specific throughput of the latter, and the translational speed of the tillage installation. Specific throughput is the ability of a separating lattice to pass a certain soil weight in one second through a unit of gap area.

The weight of the soil that passes through the gaps of the separation lattice in one second can be determined by the expression

$$Q' = \frac{1}{2t} l \cos \psi_P \, h'' b \gamma, \quad (2)$$

where t – is the travel time, $l \cos \psi_P$, s; h' – thickness of the soil layer sifted through the separating lattice, m; b – the width of the finely cloddy soil layer covering the seeds, m; γ – is the volumetric weight of the soil, kg/m^3. The travel time $l \cos \psi_P$ is determined by the expression

$$t = \frac{l \cos \psi_P}{V_M}, \quad (3)$$

where V_M – is the translational speed of the machine, m/s.

Throughput of the separating lattice in one second is found using its specific throughput according to the formula:

$$Q' = Ql \cos \psi_P \, b'(z+1), \quad (4)$$

where Q – is the specific throughput of the separating grate, kg/m^{3}s; b' – the distance between the rods of the separating lattice, m; z – is the number of rods in the separating lattice, pcs.

From the equation:

$$V_П = \frac{V_M}{\cos \psi_P}, \quad (5)$$

where $V_П$ – is the speed of the soil along the separating grid, V_M – is the translational speed of the tillage machine m/s; ψ_P – is the angle of inclination of the separating lattice.

From the equation:

$$V_0' = V_o \cos(\alpha_{вх} + \psi_P), \quad (6)$$

where V_0' – is the projection of the peripheral speed of the rotor knife on the surface of the movable separating lattice, m/s; V_0 – is the peripheral speed of the rotor knife, m/s; $\alpha_{вх}$ – the angle of entry of the rotor knife into the soil. It is seen that: $\psi_P = 0$, the peripheral speed of the rotor knife, necessary to move the soil along the separating lattice, can be reduced to a minimum.

So, to reduce the rotor speed, the separating lattice must be placed horizontally.

The distance between the rods of the separating lattice is determined by the agro-technical requirements for the soil structure in the seed embedding zone. To exclude particles larger than 10 mm from this zone, the distance between the rods of the separating lattice should be equal to or less than the specified size.

The experimental field installation works as follows. The working bodies cut the soil at a given depth of cultivation and raise it. This ensures preliminary grinding of the soil, which is then fed to the separating lattice by a rotary working body. Knives of a rotating rotor with a relatively low speed pick up a layer of soil and move it further along the lattice. This ensures the active grinding and separation of the cut soil layer. Lumps of soil of a small fraction wake up behind a wing of a flat-cutter paw through a lattice and find themselves at the depth of the trimmed layer. Large lumps crumble with rotor knives and wake up through the grate, occupying a position above the fine fraction. Lumps, the linear dimensions of which are larger than the step of the separating lattice, leave it and occupy a position on the surface of the cultivated soil. Here are the crop residues and rhizomes of plants that cover the surface of the soil, forming plant mulch.

Since the rotor knives pass between the rods of the separating lattice, their mutual cleaning of weeds and soil is ensured. At the same time, the rotor knives do not reach the bottom of the furrow, leaving its bottom tight.

Results

This experiment was carried out jointly with the laboratory of soil physics of the National Science Center "Institute of Soil Science and Agrochemistry named after A. N. Sokolovsky". The results of field tests (only for fractions with a size of 10-1 mm) are given in table. 2.

Table 2

The crumbling of the seed layer, depending on the rotational speed of the rotor of the tillage installation with different initial parameters of moisture and soil density

Output parameters of the soil		The output of aggregates (%) with a size of 10-1 mm at a rotor speed, rpm		
humidity,%	Mass density of the structure, g/cm^3	99	127	180
11,4	1,14	36,4	50,2	33,2
	1,19	43,7	55,7	47,8
	1,32	24,2	26,2	33,9
14,4	1,21	50,6	48,1	50,5
	1,38	51,9	30,0	47,1
	1,45	53,4	35,8	30,6
23,6	1,06	69,6	68,7	74,4
	1,26	60,5	73,4	58,0
	1,36	45,2	55,6	49,5

Table 3

The reliability of the data, determined by the Fisher criterion

One-factor dispersion analysis organized repetitions			
number	average	standard deviation	relative deviation (%)
1	39.933	9.034	22.623
2	49.067	6.099	12.431
3	28.100	5.122	18.226
4	49.733	1.415	2.846
5	43.000	11.511	26.770
6	39.933	11.949	29.922
7	70.900	3.065	4.322
8	63.967	8.265	12.920
9	50.100	5.226	10.431

Influence of the factor share	
source of influence	determination index
V-option	79.20
iteration	0.38
random	20.42

Analysis of the variation table				
a source	quadrotic mean	degree of freedom	F-Fisher experimental	F-Fisher tabular
V-option	501.83	8	7.76	2.59
Z-residual	64.70	16		
P-factor	9.76	2	0.15	3.63

Statistical characteristics	
matrix average	48.304
standard deviation	8.043
error of experience (average)	4.644
accuracy indicator, %	9.614
mean difference error	6.567
smallest existing difference	13.923

The reliability of the data, determined by the Fisher criterion, is 95%. The influence of the factor is 79.2%. The smallest significant difference is 13.923%.

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Processing data by the method of factor analysis allowed us to come to more specific conclusions.

To do this, we determined the effect of each of the investigated factors on grinding by approximately the same other two factors. The result is shown in table.

Table 4

The influence of the studied factors on the crumbling of the soil

Factor	Level of factor	Crumbling soil,%
rotation frequency rotor, about rpm	99	48,4
	127	49,3
	180	47,2
soil density	small	53,5
	moderate	52,0
	increased	39,4
Soil moisture	small	39,0
	moderate	44,2
	optimal	61,7

After processing the experimental data, a mathematical model of soil crumbling was obtained

$$Z = 95{,}5 - 0{,}04 W^{3} p^{3} - 25{,}2 p^{2} + 2{,}82 \upsilon^{2/3} + 0{,}82 W^{1{,}5} p^{2{,}5} + 0{,}03 W^{1{,}5} p^{1{,}5} \upsilon^{1/3} - 22{,}2 p \upsilon^{1/3}, \quad (7)$$

where: W–soil moisture%; p–soil structure density, g/cm^3; υ–rotor speed, vol./min.

Discussion

Based on this model, a graph of surfaces was constructed $Z(W, p)$; $Z(W, \upsilon)$; $Z(p, \upsilon)$; Z(W); Z(g) subject to fixation, υ, $p$and$W$,p, respectively, at the levels of their average values in the experiments. For practical purposes, approximations to the quadratic model are carried out. The results of regression multivariate analysis are shown in Fig. 4.

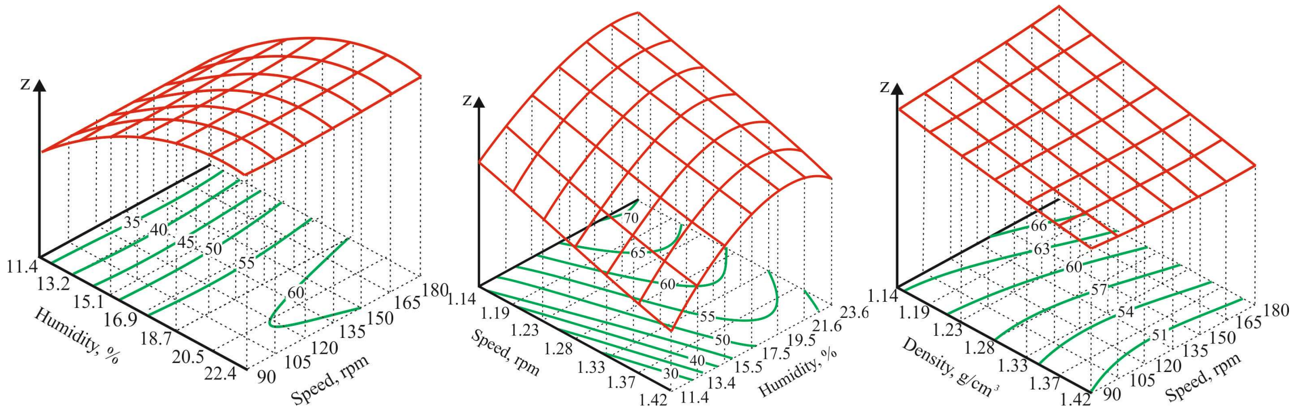

Fig.4. **Crumbling of the seed layer (Z) depending on the rotational speed of the rotor of the tillage plant with various initial parameters of moisture and density of the soil structure.**

Active soil grinding by a tillage installation has proven effective with a wide range of output parameters of the structure density and humidity of the surface soil layer. With an increase in the rotor speed, a tendency towards a decrease in the number of lumps (> 10 mm) was manifested. The efficiency of increasing the speed increased with unfavorable parameters of soil density and moisture. Even in variants with increased parameters of the structure density (1.3-1.4 g/cm3) after the passage of the installation, it was possible to obtain a seed layer with a satisfactory content of agronomic useful lumps.

It should be borne in mind that when analyzing the data obtained, some of their inconsistency is explained by the fact that we were not able to create equal conditions for the initial density of the structure before processing (crumbling) due to the different humidity of the seed layer of the soil. For example, at the slightest moisture in the soil, the range of the created structure density was 1.14-1.32 g/cm3, average humidity 1.21-1.45 g/cm3, and increased 1.06-1.36 g/cm3. That is, during the experiment we were not able to create comparable conditions of crumbling soil. But certain patterns were discovered.

1. As expected, the largest (almost optimal) quantity of agronomic valuable lumps was obtained with physical ripeness of the soil and with its loose and moderately compacted structure. It is important that under these conditions, the rotor speed does not matter much. The soil disintegrates almost equally well into agronomic valuable lumps at both minimum and maximum speed. But when the initial soil structure density of 1.36 g/cm3 is achieved, grinding is significantly degraded, and with an increase in the rotor speed, there is an obvious tendency to improved crumbling.

2. With a decrease in the output level of soil moisture to the lower limit of plasticity and, especially, to 0.5 physical ripeness of soil, it deteriorates significantly. The lowest crumbling rates (24-34%) are observed at the highest initial soil structure density 1.32 g/cm3 and higher. But even in this case, increasing the rotor speed raises the quantity of valuable structural lumps.

Conclusions. It was determined that the output parameters of the soil moisture and structure density significantly affect its grinding by the working bodies of the experimental tillage installation. This process acquires a particularly unfavorable character at the maximum density and minimum soil moisture in the seed layer. The influence of the rotor significantly affects the output of agronomic valuable aggregates (compared with the worst indicators of crumbling). To a certain extent, even the minimum rotor speed is sufficient to optimize crumbling. With increasing rotor speed, there is a clear tendency to improve crumbling, especially with unfavorable parameters of structure density and soil moisture.

References

1. Syromjatnikov, Ju. N. (2021). Obosnovanie parametrov ryhlitelja pochvoobrabatyvajushhej mashiny stratifikatora. Inzhenernye tehnologii i sistemy. 31, (2), 257–273. [in Russian].
2. Syromyatnikov, Y. N., Khramov, N. S. (2021). The process of lifting the soil by the working bodies of the tillage loosening-separating unit. Podilian Bulletin: Agriculture, Engineering, Economics. 33, 86–96. [in Ukrainian].
3. Syromyatnikov, Y. et al. (2021). Productivity of tillage loosening and separating machines in an aggregate with tractors of various capacities. Journal of Terramechanics. 98, 1–6. [In English].
4. Syromjatnikov, Ju. N., Khramov, N. S. (2020). Opredelenie tjagovogo soprotivlenija ustrojstva dlja podema pochvy v zavisimosti ot ugla postanovki napravljajushhih diskov. Agrarnaja nauka-sel'skomu hozjajstvu, 78–80. [in Russian].
5. Syromjatnikov, Ju. N. (2018). Rabochie organy dlja podrezanija i podjoma pochvy pochvoobrabatyvajushhej ryhlitel'no-separirujushhej mashiny. Vestnik agrarnoj nauki Dona. 3, 49–56. [in Russian].
6. Olesen, J.E., Munkholm, L.J. (2007). Subsoil loosening in a crop rotation for organic farming eliminated plough pan with mixed effects on crop yield. Soil and Tillage Research. 94 (2), 376–385. [In English].
7. Starovojtov, S. I., Ahalaja, B. H., Mironova, A. V. (2019). Konstruktivnye osobennosti rabochih organov dlja uplotnenija i vyravnivanija poverhnosti pochvy. Jelektrotehnologii i jelektrooborudovanie v APK. 4, 51–56. [in Russian].
8. Chaudhary, V.P., Singh, B. (2002). Effect of zero, strip and conventional till system on performance of wheat. Journal of Agricultural Engineering. 39 (2), 27–31. [In English].
9. Celik, A., Altikat, S. & Way, T.R. (2013). Strip tillage width effects on sunflower seed emergence and yield. Soil and Tillage Research. 131, 20–27. [In English].
10. Hossain, M.I. et al. (2014). Strip tillage seeding technique: a better option for utilizing residual soil moisture in rainfed moisture stress environments of north-west Bangladesh. Int J Recent Dev Eng Technol. 2, 132–136. [In English].
11. Wuest, S. (2007). Vapour is the principal source of water imbibed by seeds in unsaturated soils. Seed Science Research. (1), 3–9. [In English].
12. Wuest, S.B. (2002). Water transfer from soil to seed. Soil Science Society of America Journal. 66 (6), 1760–1763. [In English].
13. Arnold, S. et al. (2014). Effects of soil water potential on germination of co-dominant Brigalow species: implications for rehabilitation of water-limited ecosystems in the Brigalow Belt bioregion. Ecological Engineering. 70, 35–42. [In English].
14. Parhomenko, G. G. et al. (2021). Agrotehnicheskie i jenergeticheskie pokazateli pochvoobrabatyvajushhih rabochih organov. Inzhenernye tehnologii i sistemy. 30, 1. 109–126. [in Russian].
15. Hou, X. et al. (2012). Effects of rotational tillage practices on soil properties, winter wheat yields and water-use efficiency in semi-arid areas of north-west China. Field crops research. 129, 7–13. [In English].
16. Koller, K., El Titi, A. (2003). Techniques of soil tillage. Soil tillage in agroecosystems. 1–25. [In English].
17. Hamza, M.A., Anderson, W.K. (2005). Soil compaction in cropping systems: A review of the nature, causes and possible solutions. Soil and tillage research. 82, (2), 121–145. [In English].
18. Medvedev, V.V. (2013a). Physical degradation of chernozems. Diagnostics. Causes. The consequences. Warning. Kharkov: City Printing House. 324. [in Russian].
19. Medvedev, V.V. (2013b). Physical properties and soil treatment in Ukraine. Kharkov: City Printing House. 224. [in Russian].
20. Medvedev, V.V., Laktionova, T.N. (2011). Granulometric composition of Ukrainian soils (genetic, environmental and agronomic aspects). Kharkov: Apostrophe. 292. [in Russian].
21. Medvedev, V.V. (2010). Standards are a key element of a high crop culture. Agriculture. 8, 6–7. [in Russian].
22. Melnik, V.I., Kalyuzhny, O.D., Ridny, R.V. (2017). Liquid chemicals unit dosing and delivery module. Environmental Engineering. 1 (7), 76–79. [in Ukrainian].
23. Melnik, V.I. et al. (2018). Improvement of the rotary spreader of organic fertilizers. Environmental Engineering. 2 (10), 59–62. [In English].
24. Aniskevich, L.V. (2005). Control systems for the norms of making materials in precision farming technologies: abstract of the dissertation of the doctor of technical sciences. 36. [in Ukrainian].

25. Medvedev, V.V. (2007). Soil heterogeneity and precision farming. Kharkov: «13th printing house». 296. [in Russian].
26. Kunz, C., Weber, J., Gerhards, R. (2015). Benefits of precision farming technologies for mechanical weed control in soybean and sugar beet – comparison of precision hoeing with conventional mechanical weed control. Agronomy. 5 (2), 130–142. [In English].
27. Cooper, J. et al. (2016). Shallow non-inversion tillage in organic farming maintains crop yields and increases soil C stocks: a meta-analysis. Agronomy for sustainable development. (1). 22. [In English].
28. Barwicki, J., Gach, S., Ivanovs, S. (2012). Proper Utilization of the Soil Structure for the Crops Today and Conservation for Future Generations. Proceedings of 11-th International Scientific Conference «Engineering for Rural Development». 11, 10–15. [In English].
29. Bottinelli, N. et al. (2015). Why is the influence of soil macrofauna on soil structure only considered by soil ecologists? Soil and Tillage Research. 146, 118–124. [In English].
30. Guimarães R. M. L. et al. (2013). Relating visual evaluation of soil structure to other physical properties in soils of contrasting texture and management. Soil and Tillage Research. 127, 92–99. [In English].
31. Nanka, O.V., Syromjatnykov, Ju.M. (2019). Rezul'taty pol'ovyh vyprobuvan' eksperymental'noi' g'runtoobrobnoi' ustanovky. Visnyk Harkivs'kogo nacional'nogo tehnichnogo universytetu sil's'kogo gospodarstva. 201, 191–202. [in Ukrainian].
32. Nanka, O.V., Siromjatnikov, Ju.M. (2019). Vpliv chastoti obertannja rotora g'runtoobrobnoї eksperimental'noї ustanovki na pokazniki jakosti. Tehnichnij servis agropromislovogo, lisovogo ta transportnogo kompleksiv. 15, 96–110. [in Ukrainian].
33. Pashchenko V. F., Syromyatnikov Y. N. & Khramov N. S. (2018). G'runtoobrobna ustanovka z vykorystannjam gnuchkogo robochogo organu dlja kontrolju rostu bur'janiv. Vegetable and Melon Growing. 64, 33–43. [in Ukrainian].
34. Pashhenko, V. F. et al. (2016). Obg'runtuvannja docil'nosti derzhavnoi' pidtrymky vitchyznjanogo sil'gospmashynobuduvannja. Visnyk Harkivs'kogo nacional'nogo tehnichnogo universytetu sil's'kogo gospodarstva imeni Petra Vasylenka. 173, 53–68. [in Ukrainian].
35. Syromjatnykov, Ju. M. (2017). Vdoskonalennja robochyh organiv dlja pidrizannja ta pidjomu g'runtu rozryhljuval'no-separujuchoju mashynoju. Inzhenerija pryrodokorystuvannja. 2, 74–77. [in Ukrainian].

Д.В. Бабенко, М.С. Храмов, Ю.М. Сиромятников, І.М. Суковіцина. **Польові випробування експериментальної ґрунтообробної установки**

Розглянуто результати дослідження технологічного процесу обробітку ґрунту, конструктивно-технологічні схеми органів ґрунтообробної установки. Експериментально встановлено, що на якість кришіння ґрунту експериментальною розрихлювально-сепаруючою установкою особливий вплив робить вологість та щільність складання, тому при щільності ґрунту 1,3-1,4 г/см³ та мінімальній вологості ґрунту 11,4-14,4% частоту обертання ротора необхідно збільшити до 127 об/хв.

Ключові слова: *обробіток, культивація, шар ґрунту, ротор, диференціація.*

Д.В. Бабенко, Н.С. Храмов, Ю.Н. Сыромятников, И.Н. Суковицына. **Полевые испытания экспериментальной почвообрабатывающей установки**

Представлены результаты исследования технологического процесса обработки, конструктивно-технологические схемы органов почвообрабатывающей установки. Экспериментально установлено, что на качество крошения почвы экспериментальной рыхлительно-сепарирующей установкой особое влияние оказывает влажность и плотность состава, поэтому при плотности почвы 1,3-1,4 г/см³ и минимальной влажности почвы 11,4-14,4% частоту вращения ротора необходимо увеличить до 127 об/мин.

Ключевые слова: *обработка, культивация, слой почвы, ротор, дифференциация.*