

Polish Academy of Sciences Branch in Lublin  
University of Engineering and Economics in Rzeszów  
National University of Life and Environmental Sciences of Ukraine

# **TEKA**

COMMISSION OF MOTORIZATION AND ENERGETICS IN AGRICULTURE

AN INTERNATIONAL QUARTERLY JOURNAL  
ON MOTORIZATION, VEHICLE OPERATION,  
ENERGY EFFICIENCY AND MECHANICAL ENGINEERING

Vol. 18, No 3

LUBLIN-RZESZÓW 2018

**Linguistic consultant:** Ivan Rogovskii  
**Typeset:** Lyudmila Titova, Adam Niezbecki  
**Cover design:** Hanna Krasowska-Kołodziej

All the articles are available on the webpage:  
<http://www.pan-ol.lublin.pl/wydawnictwa/Teka-Motrol.html>

All the scientific articles received positive evaluations by independent reviewers

ISSN 1641-7739

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**Printing**

Elpils  
Arteleryjska Str. III, 08-110 Siedlce, Poland  
e-mail: info@elpils.com.pl

Edition 150+17 vol.

## Methodology of Experimental Research of Hydroseeding Process of Gemitated Grain

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Received June 01.2018; accepted September 21.2018

**Summary.** The population of Ukraine is not provided with a sufficient number of vegetables. Insufficient amount of moisture in spring needs to improve the technology of vegetable crops sowing.

The work is devoted to the experimental study of the possibility to seed sprouted vegetable grain together with liquid. The article deals with the process of hydroseeding of germinated grain in which the most effective working parameters of the hydroseeder are realized. A new technological scheme for mixing of the seed mixture without traumatization of sprouters with the help of a mixing chamber of aerodynamic action is studied.

The proposed designs of hydroseeders and sowing machines due to their imperfections did not find implementation into production. The analysis of existing structures indicates that the degree of their introduction is the result of low evenness of seeding and high damaging of sprouts.

The experimental research program includes determination of the even distribution of seeds in the mixing chamber in the conditions of various air pressures and water levels in the chamber, determination of the evenness of seeding depending on the number of seeds in the mixing chamber, determination the seed lifting speed depending on the size characteristics, determination of the optimal loss rate of the water and seed mixture in the hydroseeding process.

The article deals with the materials of laboratory tests of the stationary experimental model of the hydroseeding apparatus. The research was conducted in the stationary mode with the use of modern equipment and methods of conducting scientific studies with the help of computer technologies. The purpose of experiments includes the definition of empirical coefficients that are determined by the test results. On the base of the conclusions on the article materials it is possible to develop of an optimal field research plan which can confirm the scientific hypothesis of the dependence of the evenness of seeding of germinated grain on the evenness of their distribution in the mixing chamber.

The interconnection of the structural and technological parameters of the seeding process of the

hydromixture with the efficiency of the technological process is experimentally proved.

**Key words:** experiment, plan of the experiment, installation, factor randomization, empirical coefficients.

### INTRODUCTION

The programme of experimental research includes determination of the even distribution of seeds in the mixing chamber in the conditions of various air pressures and water levels in the chamber, determination of the evenness of seeding which depends on the number of seeds in the mixing chamber, determination the seed lifting rate depending on the size characteristics, determination of the optimal flow rate of the water and seed mixture in the hydroseeding process.

### THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

The scientific researches [1-21] are devoted to the design of the hydroseeding apparatus, which would allow the seeding of germinated seeds with simultaneously irrigation in small doses of water.

Uninvestigated parts of general matters defining. V.F. Pashchenko and other authors proposed a method of seeds placing into the soil and a device for its implementation, which transports the seeds to the coulter by a liquid flow under pressure from the hydraulic pump. The disadvantage of this process is inability to plant the germinated seeds.

A well-known hydraulic seeding machine of such authors as M.F. Olkhovskyi and S.V. Halimonenko includes a tank with an agitator placed in it (the tank has an outlet which is equipped with a locking device installed in the distribution chamber), a control system that is installed in direct brackets with the possibility of vertical displacement of a spring loaded container. The disadvantages of these hydroseeder is an unstable regulatory effect on the pouring of water and seeds

mixture. This sowing machine is unsatisfactory in open ground.

The patent search and the review of literary sources allowed revealing other models of hydroseeders. However, the proposed designs of hydroseeders and sowing machines due to their imperfections did not find implementation into production. The analysis of existing models indicates that the degree of their introduction is the result of low evenness of seeding and high damaging of sprouts.

## OBJECTIVE

Purpose of the article is theoretical investigation of the hydroseeding process of fine vegetable germinated seeds.

## THE MAIN RESULTS OF THE RESEARCH

The experimental research program includes determination of the even distribution of seeds in the mixing chamber in the conditions of various air pressures ( $\alpha$ ) and water levels in the chamber ( $\beta$ ), determination of the evenness of seeding depending on the number of seeds in the mixing chamber, determination the seed lifting speed depending on the size characteristics, determination of the optimal loss rate of the water and seed mixture in the hydroseeding process.

To determine the even distribution of seeds in the volume of liquid under the action of air bubbles, we need to know their relative position with respect to each other.

The information on the theoretical and experimental determination of the distances between the seeds relative to the X, Y, Z axes and the effect on their values of the air pressure parameters and the liquid level in the chamber ( $\alpha$  and  $\beta$ ) was not found in special publications. For an analytical solution of the equation of kinematics of seeds in a liquid, we need to determine experimentally the nature of the movement of seeds in the liquid under the influence of air pressure, velocity, and the trajectory of their ascent.

To determine the trajectory and the ascending speed depending on the air pressure delivered through the perforated bottom of the chamber, we developed a laboratory-field unit that meets the following requirements:

1. The unit is provided with pressure control and the control of the size of the holes in the perforated bottom of the mixing chamber (the size of the holes A in the range 1-2 mm and the air pressure B in the range 0.1-0.6 atm.).

2. In the course of the experiment it is provided:

- the measurement of seed ascending speed (measurement error is 0.1 s),
- the measurement of the density of the liquid,
- the measurement of travelling speed  $v_n$  unit,
- the measurement of the process of seed distribution in the volume of the liquid.

3. Registration of information is carried out using a laptop with software for further information processing.

To install various perforated discs and maintain air pressure, the design of the unit has been constructed, providing the necessary range of factors A and B (Fig. 1).

To measure the lifting speed of seeds a measurable bulb with photodetectors was made. The photodetectors record the time of seeds lifting in the range of 0,8-20 Hz to within 5%.



a



b

**Fig. 1.** The design concept of the unit a - the replacement of perforated discs of the bottom of the mixing chamber b- the regularity of the air pressure  $\beta$ .



**Fig. 2.** Installation of WEB-cameras.

For a visual observation of the process of interaction of seeds with air bubbles on a frame, the Microsoft Life Cam VX-70 webcam is rigidly mounted (Fig. 2)

All information from the sensors is translated into a digital code using the digital amplifier and converter Spider 8, then recorded and stored in the memory of the Omnibook-600 laptop computer (Fig. 3).



a

	A	B	C	D	E
1	File comment:				
2	Time	Chastota k	Chastota c	TenzoZveno	
3	s	Hz	Hz	kg	
4					
5					
6	0	0,064	0,036	11,81354	
7	0,04	0,064	0,036	11,81354	
8	0,08	0,064	0,036	11,81354	
9	0,12	0,064	0,036	11,81354	
10	0,16	0,064	0,036	11,81354	
11	0,2	0,064	0,036	11,81354	
12	0,24	0,064	0,036	11,81354	
13	0,28	0,064	0,036	11,81354	
14	0,32	0,064	0,036	11,81354	
15	0,36	0,064	0,036	11,81354	
16	0,4	0,064	0,032	11,81354	
17	0,44	0,06	0,032	11,81354	
18	0,48	0,06	0,032	11,81354	
19	0,52	0,06	0,032	11,81354	
20	0,56	0,06	0,032	11,81354	
21	0,6	0,06	0,032	11,81354	
22	0,64	0,06	0,032	11,81354	
23	0,68	0,06	0,032	11,49425	

b

**Fig. 3.** Conducting a field experiment: a - measuring complex, b - registration of information on a laptop.

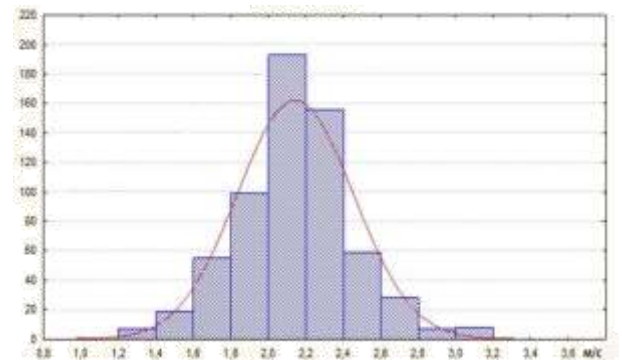
In column A the time of seeds lifting is fixed, in column B the bubble separation frequency is fixed, in column C the frequency of operation of the photodetector is fixed, and in column D the value of height of the liquid column above the seed catcher is fixed. The data is recorded with a frequency of 25 data per second. Further data processing is done using Statistica 6.0 software.

The methodology of experimental studies to determine the even distribution of seeds in the seedbed depends on the diameter of the seed catcher  $\alpha$  and the height of the water and seed mixture over the level of the funnel  $\beta$ .

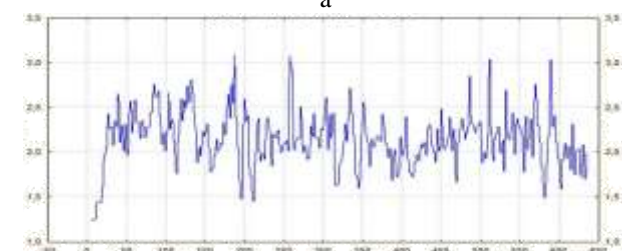
The experimental research is based on the methodology of the multifactorial experiment.

To organize and conduct multifactorial experiments it is necessary to perform the following stages of work: preliminary study of the research object, choice of factors and plan of experiments, factors coding, developing a matrix for planning experiments, randomization of experimental studies, conducting experiments, analysis and processing of the results, determination of regression coefficients, estimation of significant regression coefficients, constructing of a polynomial model and checking it for adequacy [7].

Preliminary evaluation of available research results and analysis of the process of interaction of air bubbles with seeds in a liquid medium allow to advance the hypothesis that the even distribution of seeds above the level of the funnel is nonlinear functions of air pressure  $\alpha$ , the diameter of the openings of the perforated chamber bottom of the mixer  $\beta$  discs, as well as the level of the mixture over the catcher. At the first solving of the problem, a three-factor experiment is wanted. But the research experiments under field conditions made us certain that it was impossible to fix a "progressive speed" at a given level. The large speed range on the histogram practically covers the entire range of possible level variations from 0.5 to 1.5 m/s (Fig. 4).



a

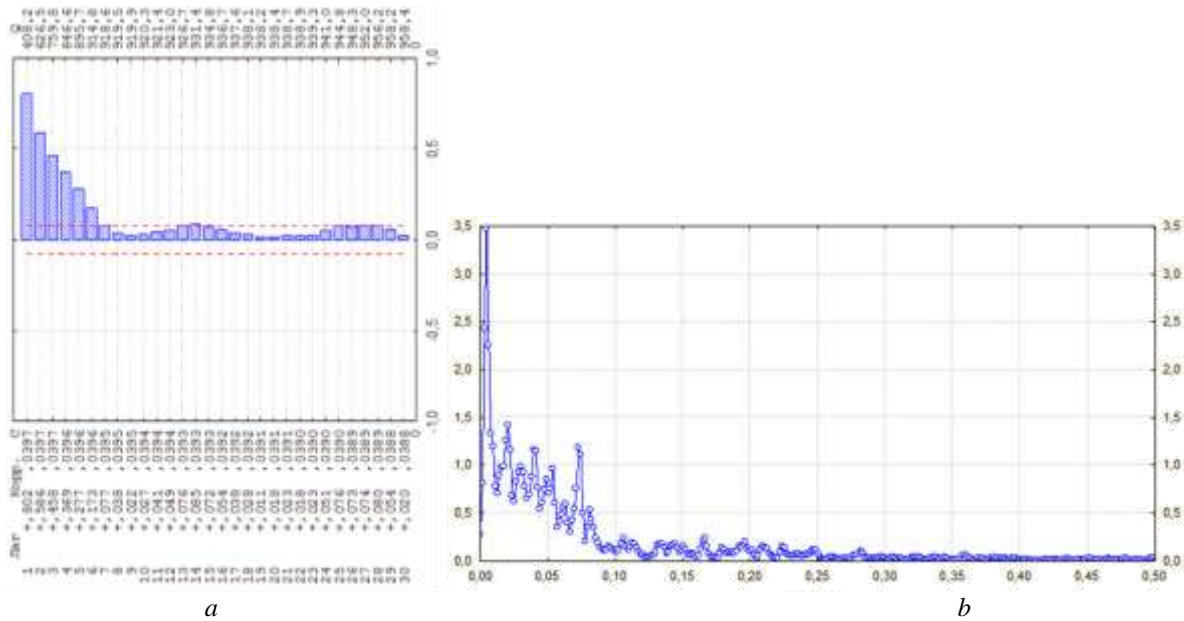


b

**Fig. 4.** Diagram of the unit speed measurements in time (a) and histogram of the unit speed (b).

The nature of the autocorrelation function and the spectral plane (Fig. 4) proved that under field conditions the unit speed can act as a controllable factor in multifactorial experiments (Fig. 5).

Thus, this raises the challenge to conduct a two-factor experiment of the second order. New studies on the theory of a multifactorial experiment show that used in practice orthogonal central composite plans (OCCP) and other plans for constructing of polynomial models of the second order are redundant in both the number of experimental points and the number of levels of factors variation.



**Fig. 5.** Correlation function (a) and spectral density of the unit (b).

For example, for four factors the number of experimental points in the OCCP is 25, and the number of unknown coefficients in the complete model of the second order is 15. Therefore, to check the adequacy of the model there are 10 degrees of freedom.

For a number of factors greater than or equal to three, the number of levels of variation in the OCCP is five, at the same time, for the construction of the models of the second order three levels of variation of factors are enough. Hence, the OCCP is redundant both in the number of experimental points, and in the number of levels of factors variation.

The number of experimental points in the matrix of the OCCP is calculated by the formula:

$$N = 2^n + 2n + 1 \quad (1)$$

where  $N$  is the number of experimental points,  $n$  is the number of factors.

The process model in the two-factor experiment of the second order is in the following form:

$$y = b_0 + b_1x_1 + b_2x_2 + b_{11}x_1^2 + b_{22}x_2^2 + b_{12}x_1x_2 \quad (2)$$

where  $y$  is the investigated factor,  $x_1$  and  $x_2$  - variable factors,  $b_0, b_1, b_2, b_{11}, b_{22}, b_{12}$  - empirical coefficients that need to be determined by the results of a multivariate experiment.

There is a large variety of plans for two-factor experiments of the second order. They are almost equivalent as for reflection of the reality of the described processes, but differ in the scope of experimental work [4].

As an alternative, consider the three most common points of the plan:

1. The central composite rotatable plan of the second order for two factors.

For realization of this plan it is necessary to conduct 13 experiments, if necessary, to identify 6 unknowns. Provision of parameters of the regulated factor at star

points in values of +1.414 and -1.414 is sometimes very problematic.

2. Central noncomposite plan of the second order. For realization of this plan it is necessary to conduct ten variants of the experiment. It is very difficult to provide  $x_2$  parameters at levels +0.866 and -0.866.

3. The two-factor orthogonal central composite plan (OCCP) of the second order has recently been used in engineering practice due to a number of advantages over other plans. The feature of the task is that the object of the study is not the process itself, but statistical indicators that characterize this process in a steady state. In this case, the initial value is determined almost without error (due to a large number of measurements), and the result of each experiment is accurately reproduced in its repetition, if there are no random emissions.

Hence, there is no need to check the uniformity of sampling variances of reproducibility, in the conduct of randomization and duplication of experiments. At the same time, it is difficult to assess the significance of the coefficients and to check the adequacy of the mathematical model in the form of a polynomial.

The verification of the adequacy of approximating expressions on F-criteria and the significance of the coefficients on t-criteria in this case is inappropriate, since the sampling variance of reproducibility in determining the values of  $y$  according to the graph is practically zero. At the same time, all the coefficients, even slightly different from zero, will be significant, and any deviations of the calculated by polynomial value  $y$  from the values  $\bar{y}$  (taken from the characteristic) formally make the model inadequate. A similar problem of adequacy and significance of coefficients arises also when studying the mathematical model of an object on a computer.

In this case, the following ways are acceptable: consider all the coefficients significant, since the variance of experiments is practically absent (due to its lower significance), the estimation should be made on the basis of the accepted level of approximation accuracy, which is

connected with the artificial introduction of the variance of reproducibility. Taking the value of the error of experiment for the initial parameter, the verification of the model adequacy can be made according to the F-criterion.

However, the correspondence of the approximating polynomial of an approximating curve or their family can be determined by the maximum absolute deviation of the values of the initial parameter calculated by polynomial from the values determined by the statistical characteristic.

The last way inferior to the mathematical rigor of the first two. However, considering the graphic description of the statistical properties of the object, this way is quite acceptable under the approximation of statistical characteristics [1].

The special features of experimental methods for mathematical representation of statistical characteristics include the fact that in this case the experiment (defining initial parameter values using the diagram) does not require a lot of time and resources. The experiment is not expensive. Therefore, the question of minimizing of the number of necessary experiments is not as acute as when planning an industrial experiment. In the general case, there is no need for the consistent nature of the experiment, since the character of the statistical characteristics is already known. For example, if the statistical characteristic shows that the connection  $y = f(x_1, x_2)$  is non-linear, then, as a rule, there is no need to use more simple models [5].

Because of some difficulty of estimating the adequacy of the model, it seems appropriate to use nonlinear plans even in the cases where the nonlinearity of statistical characteristics is hardly noticeable. The degree of nonlinearity can be inferred by the value of the coefficients under the quadratic terms of the polynomial. Nonlinear plans are more versatile.

Enter the next range of air pressures and the levels of the mixture over the seed catcher:

$$\alpha_{\min} = 1 \text{ atm.}, \alpha_{\max} = 6 \text{ atm.}, \beta_{\min} = 1 \text{ mm}, \\ \beta_{\max} = 5 \text{ mm}.$$

For multi-factorial experiment the second-order OCC-plan for two factors is used. It is presented in the table 1.

**Table 1.** OCC - plan of the second order for two factors.

Number of Experiments	$x_1$	$x_2$
1	-1	-1
2	-1	+1
3	+1	+1
4	+1	-1
5	+1	0
6	-1	0
7	0	+1
8	0	-1
9	0	0

Factors vary in the next range (table 2).

Thus, the features of this plan are 1) the smallest number of variants of research experiments from the existing (9 variants), 2) there are only three factors, which are studied and the results of the experiments are rounded up to a whole number (+1, 0, -1), 3) particularity of imagination of a priori information.

**Table 2.** Factors in the natural size.

$x_1 = \alpha$	$x_1 = 0,5 \text{ mm}$	-1
	$x_1 = 1 \text{ mm}$	0
	$x_1 = 1,5 \text{ mm}$	+1
$x_2 = \beta$	$x_2 = 0,1 \text{ atm.}$	-1
	$x_2 = 0,3 \text{ atm.}$	0
	$x_2 = 0,6 \text{ atm.}$	+1

## CONCLUSIONS

1. The scientific fundamentals of principles of action and design of a hydroseeder for seeding of fine vegetable germinated seeds are examined.

2. The mathematical models of some processes are proposed. The using of them allows dividing the general process of designing the hydrseeding apparatus into the following phases:

- the process of bubbling,
- the process of mixing seeds in a liquid,
- the process of water and seed mixture pouring.

3. The application of a set of physical processes makes it possible to achieve the high quality of the process of hydroseeding of sprouted seeds without traumatization of sprouters

4. The conducted theoretical studies of the hydroseeding process give the opportunity to form the main directions of experimental researches of both individual processes and the general process. Optimization of operating modes of these processes allows solving the question of the hydroseeder design. Thus, it is possible to shorten the period of having harvest of vegetable crops by reducing the period of sprouts emergence.

## REFERENCES

1. **Baraschuk V. 1984.** Planning of the experiment in the technique. Kyiv. Technics. 240.
2. **Bakhtin A. V., Chalyi V. D. 1999.** Improving the efficiency of the use of the STCP. Scientific session of MIFI. Moscow. 124.
3. **Voznesenskyi V. A. 1973.** Statistical methods of planning of an experiment in technical and technological studies. Moscow. 224.
4. **Dospekhov B. A. 1985.** Field experiment technique (with basics of statistical processing of research results). (5<sup>th</sup> ed., rev. and enl.). Moscow. Agropromizdat. 128.
5. **Kalaida V. T. 1997.** Planning of an experiment. Methods of processing of the results of the experiment and the basis of the mathematical theory of experiment planning. Tomsk, Edition of Tomsk University. 320.
6. **Klymenko M. O., Feshchenko V. P., Vozniuk N. M. 2010.** Fundamentals and methodology of

scientific research: teaching. manual. Kyiv. Agrarian Education. 208.

7. **Montgomery D. K. 1980.** Experiment planning and data analysis. Leningrad. Shipbuilding. 302.

8. **Solodov V. S. 1980.** Use, construction of mathematical models and static characteristics of energy complexes of industrial vessels. Dvigatelsestroenie. Draft Building, No. 5. 5.

9. **Stepanenko S. P., Kotov B. I., Spirin A. V. 2017.** To the question of the mathematical description of the movement of the threshed seeds in the annular channel of variable cross section. Mechanization of agricultural production. Bulletin INTOSH behalf Peter Vasilenko. Kharkov. Vol. 180. 330-339.

10. **Stepanenko S. P., Kotov B. I., Swida V. A., Koval Y. G. 2009.** The theory of separation of grain in the air stream. Design, production and operation of agricultural machinery. Vol. 39. Kirovograd. KNTU. 54-62.

11. **Adamchuk V. V. 2014.** The concept of the prospects of a comprehensive solution to the problem of post-harvest handling and storage of grain in the agricultural enterprises of Ukraine. Mechanization and electrification of agriculture. Glevaha. Vol. 99. Vol. 1. 40-56.

12. **Voronkov O. A., Rogovskii I. L. 2017.** Analytical prerequisites to transport and technological systems of transportation of production of crop production. Theses of International Scientific Conference "Globalization of scientific and educational space. innovations of transport. problems, experience, prospects" (3-12 May 2017) / Dresden (Germany) Paris (France). 47-50.

13. **Voronkov O. A., Rogovskii I. L. 2017.** Ways to reduce energy consumption in transportation and technological support for weight of transported grain crops. A collection of abstracts of the XIII International scientific conference "the Rational use of energy in technology. TechEnergy 2017" (17-19 may 2017). Kiev. 72-74.

14. **Voronkov O. A., Rogovskii I. L. 2017.** Analytical model for energy estimation of transport technological process of transportation of grain and crop products. Journal of mechanical engineering and transport. Vinnitsa: VNTU. Vol. 1. 21-28.

15. **Voronkov O. A., Rogovskii I. L. 2017.** Approach to solving the problem of management of transport system for transporting of the grain harvest. The book of abstracts of V-th international scientific conference "Innovative maintenance of organic production in agriculture" in the framework of the XXI International agricultural exhibition "AGRO 2017" (05-06 June 2017). Kiev. 44-46.

16. **Voronkov O. A., Rogovskii I. L. 2017.** Automation operators for the monitoring of vehicles for the carriage of grain bread Automatic – 2017: international conference on automatic control, Kiev, Ukraine, 13-15 September 2017: proceedings of the conference. Kiev. 181-182.

17. **Voronkov O. A., Rogovskii I. L. 2017.** Alignment of adjacent transport and technological operations of transportation of grain and crop products.

Bulletin of East Ukrainian national University named after Volodymyr Dahl. No. 3. 36-43.

18. **Voronkov O. A., Rogovskii I. L. 2017.** General principles of creation of control systems of transport streams transport grain bread. Scientific Herald of National University of Life and Environmental Science of Ukraine. Series: Technique and energy of APK. Kiev. Vol. 258. 390-399.

19. **Voronkov O. A., Rogovskii I. L. 2017.** Options of structural solutions of the system of management of transport flows transport grain bread. Scientific Herald of National University of Life and Environmental Science of Ukraine. Series: Technique and energy of APK. Kiev. Vol. 262. 361-367.

20. **Shevchuk R. S., Krupych R. 2015.** Manual vibro-impact fruit shaker/ MOTROL Commission of motorization and energetics in agriculture. – Lublin-Rzeszow, Vol. 17, №4., 153-159.

21. **Sydorchuk O., Triguba A., Makarchuk O. 2012.** Optimization of the life cycle of integrated programs for harvesting grain crops. MOTROL Commission of motorization and energetics in agriculture. Lublin, Vol. 14, №4. 131-140.

22. **Sydorchuk O., Ivasjuk I., Syatkovskyy A. 2012.** Influence subject to conditions terms of tillage, planting summer-autumn period. MOTROL Commission of motorization and energetics in agriculture. – Lublin, – Vol.14, №4. 16-20.

23. **Sydorchuk A., Ivasiuk I., Ukraynecz V. 2013.** Harmonization of the components of the technological system of soil cultivation and sowing of winter crops. MOTROL. Commission of motorization and energetics in agriculture. Lublin-Rzeszow, Vol. 15, №4. 180-186.

24. **Rogovskii Ivan. 2016.** Graph-modeling when the response and recovery of agricultural machinery. Motrol : Motorization and power industry in agriculture. Lublin. T. 18. №3. 155-164.

25. **Rogovskii I. L. 2016.** Analysis of model of recovery of agricultural machines and interpretation of results of numerical experiment. Scientific Herald of National University of Life and Environmental Science of Ukraine. Series: Technique and energy of APK. Kyiv. No 254. 424-431.

26. **Rogovskii I. L. 2017.** Probability of preventing loss of efficiency of agricultural machinery during exploitation. Scientific Herald of National University of Life and Environmental Science of Ukraine. Series: Technique and energy of APK. Kyiv. No 258. 399-407.

27. **Rogovskii I. L. 2017.** Conceptual framework of management system of failures of agricultural machinery. Scientific Herald of National University of Life and Environmental Science of Ukraine. Series: Technique and energy of APK. Kyiv. No 262. 403-411.

28. **Rogovskii Ivan. 2017.** Choice of model class and method of modeling the resilience of agricultural machinery. TEKA. An International Quarterly Journal on Motorization, Vehicle Operation, Energy Efficiency and Mechanical Engineering. Lublin–Rzeszów. Vol. 17. No 3. 101-114.

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Editors of the „TEKA” quarterly journal of the Commission of Motorization and Energetics in Agriculture would like to inform both the authors and readers that an agreement was signed with the Interdisciplinary Centre for Mathematical and Computational Modelling at the Warsaw University referred to as “ICM”. Therefore, ICM is the owner and operator of the IT system needed to conduct and support a digital scientific library accessible to users via the Internet called the “ICM Internet Platform”, which ensures the safety of development, storage and retrieval of published materials provided to users. ICM is obliged to put all the articles printed in the “TEKA” on the ICM Internet Platform. ICM develops metadata, which are then indexed in the “Agro” database.

We are pleased to announce that the magazine “TEKA of the Commission of Motorization and Energetics in Agriculture” (ISSN 1641-7739) has undergone a positive evaluation of the IC Journals Master List 2013, the result of which is granting the ICV Index (Index Copernicus Value) 69,73 pts. The resulting score was calculated on the basis of a survey submitted by the Editorial Team as well as assessments made by the professionals from Index Copernicus. We invite you to familiarize yourself with the methodology of IC Journals Master List evaluation:

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Impact Factor of the TEKA quarterly journal according to the Commission of Motorization and Energetics in Agriculture is 2,41 (September, 2018).

## GUIDELINES FOR AUTHORS (2018)

The journal publishes the original research papers. The papers (min. 5 pages) should not exceed 12 pages including tables and figures. Acceptance of papers for publication is based on two independent reviews commissioned by the Editor.

Authors are asked to transfer to the Publisher the copyright of their articles as well as written permissions for re- production of figures and tables from unpublished or copyrighted materials.

**Articles should be submitted electronically to the Editor and fulfill the following formal requirements:**

- Clear and grammatically correct script in English,
- Format of popular Windows text editors (A4 size, 12 points Times New Roman font, single interline, left and right margin of 2,5 cm),
- Every page of the paper including the title page, text, references, tables and figures should be numbered,
- SI units should be used.

**Please organize the script in the following order (without subtitles):**

Title, Author(s) name (s), Affiliations, Full postal addresses, Corresponding author's e-mail

Summary (up to 200 words), Key words (up to 5 words), Introduction, Analysis of recent researches and publications, Objectives, The main results of the research (a combined Results and Discussion section can also be appropriate), Conclusions (numbered), References, Tables, Figures and their captions.

**Note that the following should be observed:**

An informative and concise title; Abstract without any undefined abbreviations or unspecified references; No nomenclature (all explanations placed in the text); References cited by the numbered system (max 5 items in one place); Tables and figures (without frames) placed out of the text (after References) and figures additionally pre- pared in the graphical file format jpg or cdr.

Make sure that the tables do not exceed the printed area of the page. Number them according to their sequence in the text. References to all the tables must be in the text. Do not use vertical lines to separate columns. Capitalize the word 'table' when used with a number, e.g. (Table 1).

Number the figures according to their sequence in the text. Identify them at the bottom of line drawings by their number and the name of the author. Special attention should be paid to the lettering of figures – the size of lettering must be big enough to allow reduction (even 10 times). Begin the description of figures with a capital letter and observe the following order, e.g. Time(s), Moisture (% , vol), (% ,  $m^3m^{-3}$ ) or (% ,  $gg^{-1}$ ), Thermal conductivity ( $W m^{-1}K^{-1}$ ).

Type the captions to all figures on a separate sheet at the end of the manuscript.

Give all the explanations in the figure caption. Drawn text in the figures should be kept to a minimum. Capitalize and abbreviate 'figure' when it is used with a number, e.g. (Fig. 1).

Colour figures will not be printed.

**Make sure that the reference list contains about 30 items. It should be numbered serially and arranged al-phabeticly by name of first author and then others, e.g.**

7. Kasaja O., Azarevich G. and Bannel A. 2018. Econometric Analysis of Banking Financial Results in Poland. Journal of Academy of Business and Economics (JABE), Vol. IV. Nr 1, 202–210.

References cited in the text should be given in parentheses and include a number e.g. [7].

Any item in the References list that is not in English, French or German should be marked, e.g. (in Italian), (in Polish).

Leave ample space around equations. Subscripts and superscripts have to be clear. Equations should be numbered serially on the right-hand side in parentheses. Capitalize and abbreviate 'equation' when it is used with a number, e.g. Eq. (1). Spell out when it begins a sentence. Symbols for physical quantities in formulae and in the text must be in italics. Algebraic symbols are printed in upright type.

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