

INMATEH -

**AGRICULTURAL
ENGINEERING**

JANUARY - APRIL

Editorial

The National Institute of Research-Development for Machines and Installations designed to Agriculture and Food Industry - INMA Bucharest has the oldest and most prestigious research activity in the field of agricultural machinery and mechanizing technologies in Romania.

Short History

- ✓ *In 1927, the first research Center for Agricultural Machinery in Agricultural Research Institute of Romania - ICAR (Establishing Law was published in O.D. no. 97/05.05.1927) was established;*
- ✓ *In 1930, was founded The Testing Department of Agricultural Machinery and Tools by transforming Agricultural Research Centre of ICAR- that founded the science of methodologies and experimental techniques in the field (Decision no. 2000/1930 of ICAR Manager - GHEORGHE IONESCU ȘIȘEȘTI);*
- ✓ *In 1952, was established the Research Institute for Mechanization and Electrification of Agriculture - ICMA Băneasa, by transforming the Department of Agricultural Machines and Tools Testing;*
- ✓ *In 1979, the Research Institute of Scientific and Technological Engineering for Agricultural Machinery and Tools - ICSITMUA was founded - subordinated to Ministry of Machine Building Industry - MICM, by unifying ICMA subordinated to MAA with ICPMA subordinated to MICM;*
- ✓ *In 1996 the National Institute of Research-Development for Machines and Installations designed to Agriculture and Food Industry - INMA was founded - according to G.D. no.1308/25.11.1996, by reorganizing ICSITMUA, G.D no. 1308/1996 coordinated by the Ministry of Education and Research G.D. no. 823/2004;*
- ✓ *In 2008 INMA has been accredited to carry out research and developing activities financed from public funds under G.D. no. 551/2007, Decision of the National Authority for Scientific Research - ANCSno. 9634/2008.*

As a result of widening the spectrum of communication, dissemination and implementation of scientific research results, in 2000 was founded the institute magazine, issued under the name of SCIENTIFIC PAPERS (INMATEH), ISSN 1583 – 1019.

*Starting with volume 30, no. 1/2010, the magazine changed its name to INMATEH - *Agricultural Engineering*, appearing both in print format (ISSN 2068 - 4215), and online (ISSN online: 2068 - 2239). The magazine is bilingual, abstract being published in native language and English, with a rhythm of three issues / year: January-April, May-August, September-December and is recognized by CNCSIS – with B⁺ category. Published articles are from the field of AGRICULTURAL ENGINEERING: technologies and technical equipment for agriculture and food industry, renewable energy, machinery testing, environment, transport in agriculture etc. and are evaluated by specialists inside the country and abroad, in mentioned domains.*

*Technical level and performance processes, technology and machinery for agriculture and food industry increasing, according to national requirements and European and international regulations, as well as exploitation of renewable resources in terms of efficiency, life, health and environment protection represent referential elements for the magazine „INMATEH - *Agricultural Engineering*”.*

We are thankful to all readers, publishers and assessors.

Editor in chief,

Ph. D. Eng. Vladut Nicolae-Valentin

Managing Editorial Board - INMA Bucharest**Editor in Chief****VLADUȚ Nicolae-Valentin**

Ph.D.Eng, SR I

E-mail: inmatehjournal@gmail.com**Executive Editor****POPA Lucreția**

Ph.D.Eng, SR I

Assistant Editor**MATACHE Mihai-Gabriel**

Ph.D.Eng, SR I

Logistic support, database**MURARU Virgil, Ph.D.Eng, SR I****ȚICU Tania, techn.****Scientific Secretary****Cârdei Petre, math.****Official translators****RADU Daniela-Cristina, English, French****Editorial Board**

- Acad. Prof. Ph.D. TABĂRA Valeriu - Romania, President of ASAS - Academy of Agricultural and Forestry Sciences "Gheorghe Ionescu Șişești";
- Ph.D. BOGOESCU Marian - Romania, Vicepresident of ASAS - Academy of Agricultural and Forestry Sciences "Gheorghe Ionescu Șişești";
- Hon.Prof.Ph.D.Eng. PIRNA Ion - Romania, President of the Department of Agricultural Mechanization of ASAS - Academy of Agricultural and Forestry Sciences "Gheorghe Ionescu Șişești";
- Ph.D. Eng. NICOLESCU C. Mihai - Romania, Scientific General Secretary of the ASAS-Academy of Agricultural and Forestry Sciences "Gheorghe Ionescu Șişești";
- Assoc.Prof. Ph.D. Eng. BELC Nastasia - Romania, IBA Bucharest;
- Ph.D. Eng. BUȚU Alina - Romania, INSB Bucharest;
- Prof. Ph.D. Eng. PARASCHIV Gigel - Romania, P.U. Bucharest;
- Prof. Ph.D.Eng. BIRIȘ Sorin - Romania, P.U. Bucharest;
- Prof. Ph.D. Eng. VLASE Sorin - Romania, "Transilvania" University Brașov;
- Prof. Ph.D.Eng. BURNETE Nicolae - Romania, Technical University Cluj Napoca;
- Prof. Ph.D. Eng. FILIP Nicolae - Romania, Technical University Cluj Napoca;
- Prof. Ph.D. Eng. VOICU Gheorghe - Romania, P.U. Bucharest;
- Prof. Ph.D. Eng. GERGEN Iosif -Romania,USAMVB Timișoara;
- Prof. Ph.D. Eng. ȚENU Ioan - Romania, USAMV Iași;
- Assoc.Prof.Ph.D.Eng. BUNGESCU Sorin - Romania, USAMVB Timișoara;
- Prof. Ph.D.Eng. FENYVESI László - Hungary, Hungarian Institute of Agricultural Engineering Godolo;
- Assist.Prof.Ph.D.Eng. BILANDZIJA Nikola - Croatia, University of Zagreb;
- Ph.D. BIOCCA Marcello - Italy Agricultural Research Council, Agricultural Engineering Research Unit;
- Prof.Ph.D.Eng. MIHAILOV Nikolay - Bulgaria, University of Rousse;
- Assoc.Prof.Ph.D.Eng. ATANASOV At. - Bulgaria, University of Rousse;
- Assoc.Prof. Ph.D. ERTEKIN Can - Turkey, Akdeniz University Antalya;
- Prof. Ph.D.Sc. Eng. VARTUKAPTEINIS Kaspars - Latvia, Latvia University of Agriculture, Institute of Agricultural Machinery;
- ir. HUYGHEBAERT Bruno - Belgium, Walloon Agricultural Research Center CRA-W;
- Prof.Ph.D. Eng. FABBRO Dal Inacio Maria - Brazil, Campinas State University;
- Prof. Ph.D. Eng. DE WRACHIEN Daniele - Italy, State University of Milan;
- Prof. Ph.D.Guanxin YAO - P.R.China, Along Agriculture R&DTechnology and Management Consulting Co., Ltd;
- Prof. Ph.D. Eng. GONZÁLEZ Omar - Republic of Cuba, Central University "Marta Abreu" de las Villas;
- Assist. Prof.Dr. KABAŞ Önder –Turkey, Akdeniz University.
- Asist.Prof.Dr. SELVİ Kemal Çağatay - Turkey, Ondokuz Mayıs University.

In the present, *INMATEH - Agricultural Engineering* journal is indexed in the next international databases:
 ELSEVIER /SciVerse SCOPUS, CLARIVATE ANALYTICS' WEB OF SCIENCE- Emerging Sources Citation Index (ESCI),
 ULRICHS Web: Global Serials Directory, CABI, SCPIO, Index COPERNICUS International,
 EBSCO Publishing, Elektronische Zeitschriftenbibliothek

INMATEH - Agricultural Engineering**vol. 57, no.1 / 2019**

NATIONAL INSTITUTE OF RESEARCH-DEVELOPMENT FOR MACHINES AND
 INSTALLATIONS DESIGNED TO AGRICULTURE AND FOOD INDUSTRY -
 INMA Bucharest

6 Ion Ionescu de la Brad Blvd., sector 1, Bucharest

Three issues per year,
 e-ISSN: 2068 – 2239
 p ISSN: 2068 – 4215

Edited by: INMA Bucharest

Copyright: INMA Bucharest / Romania

CONTENT

		Page(s)
1.	<p>RESULTS OF LABORATORY INVESTIGATIONS OF SOIL SCREENING ABILITY OF A CHAIN DIGGER WITH ASYMMETRIC VIBRATOR ARRANGEMENT / РЕЗУЛЬТАТЫ ЛАБОРАТОРНЫХ ИССЛЕДОВАНИЙ ПРОСЕВАЕМОСТИ ПОЧВЫ НА ПРУТКОВОМ ЭЛЕВАТОРЕ С АСИММЕТРИЧНЫМ РАСПОЛОЖЕНИЕМ ВСТРЯХИВАТЕЛЕЙ PhD. Eng. Sc. Sibirev A.V., PhD. Eng. Sc. Aksenov A.G., Prof. PhD. Eng. Sc. Dorokhov. A.S. FSBSI "Federal Scientific Agronomic and Engineering Centre VIM"/ Russia</p>	9
2.	<p>INFLUENCE OF TYPES OF TRACTOR RUNNING GEARS ON THE VALUE OF HOP GARDEN ROW SPACING COMPACTION / ВЛИЯНИЕ ТИПОВ ДВИЖИТЕЛЕЙ ТРАКТОРОВ НА ВЕЛИЧИНУ УПЛОТНЕНИЯ ПОЧВЫ В МЕЖДУРЯДЬЯХ ХМЕЛЬНИКОВ As. PhD. Eng. Smirnov P.A.¹⁾, As. PhD. Ec. Makushev A.E.¹⁾, Prof. Ph.D. Eng. Kazakov Y. F.¹⁾, Prof. Ph.D. Eng. Medvedev V.I.¹⁾, As. PhD.Eng. Vasilyev A.O.¹⁾, As. PhD. Eng. Andreev R.V.¹⁾ ¹⁾Chuvash State Agricultural Academy / Russia</p>	19
3.	<p>THE OPTIMAL CHOICE OF THE CHARACTERISTIC WAVELENGTHS IN SPECTRAL IMAGING FOR CUCUMBER DOWNY MILDEW / 黄瓜霜霉病光谱图像特征波长优化选取 As. Prof. PhD.Eng. Geng C.X.¹⁾, Ms. Stud. Eng. Wang P.¹⁾, As. Prof. PhD.Eng. Qin P.L.²⁾, Eng. Zhang W.B.³⁾, As. Prof. PhD.Eng. Wang P.B.¹⁾ ¹⁾Robotics and Microsystems Centre, Soochow University, Suzhou/China; ²⁾Wisdom Agriculture College, Suzhou Polytechnic Institute of Agriculture, Suzhou/China; ³⁾Suzhou Agricultural Machinery Technology Promotion Station, Suzhou/China</p>	29
4.	<p>RESEARCH ON THE BLOCK-PORION SEPARATOR PARAMETERS INFLUENCE ON THE ADJUSTMENT RANGE OF OPERATING ELEMENTS SPEED / ДОСЛІДЖЕННЯ ВПЛИВУ ПАРАМЕТРІВ СИСТЕМИ ГІДРОПРИВОДІВ БЛОЧНО-ПОРЦІЙНОГО ВІДОКРЕМЛЮВАЧА НА ДІАПАЗОН РЕГУЛЮВАННЯ ШВИДКОСТІ РОБОЧИХ ОРГАНІВ Ph.D. Ivanov M.I.¹⁾, Ph.D. Rutkevych V.S.¹⁾, Ph.D. Kolisnyk O.M.¹⁾, Ph.D. Lisovoy I.O.²⁾ ¹⁾Vinnitsia National Agrarian University / Ukraine; ²⁾Uman National University of Horticulture</p>	37
5.	<p>EVALUATION OF IMPACT SYSTEMS NOISE LEVEL IN GRAIN PRODUCTION / ОЦЕНКА УРОВНЯ ШУМА УДАРНЫХ СИСТЕМ В ЗЕРНОПРОИЗВОДСТВЕ Prof. Dr. Eng.Sc. Rodimtsev S.A., Prof. Dr. Eng.Sc. Kuznetsov Y.A., Prof. Dr. Eng.Sc.Kolomeichenko A.V., Assoc. Prof., PhD Eng. Sc. Goncharenko V.V., Senior Lecturer Patrín E.I., PhD. Phil. Sc., Assoc. Prof. Mikhaylova Y.L. Orel State Agrarian University named after N.V. Parakhin / Russia</p>	45
6.	<p>MATHEMATICAL MODELING AND NUMERICAL SIMULATION OF THE DRYING PROCESS OF SEEDS IN A PILOT PLANT / MODELAREA MATEMATICĂ ȘI SIMULAREA NUMERICĂ A PROCESULUI DE USCARE A SEMINTELOR ÎNTR-O INSTALAȚIE PILOT Assist. Ph.D. Eng. Arsenoia V.N.*¹⁾, Ph.D. Eng. Vlăduț V.²⁾, Prof. Ph.D. Eng. Țenu I.¹⁾, Ph.D. Eng. Vocea I.²⁾, Lecturer Ph.D.Eng. Moiceanu G.³⁾, Assoc. Prof. Ph.D. Eng. Cârlescu P. M.¹⁾ ¹⁾ University of Agricultural Sciences and Veterinary Medicine Iași / Romania; ²⁾INMA Bucharest / Romania; ³⁾ Politehnica University of Bucharest / Romania</p>	55
7.	<p>THE INFLUENCE OF BASIC PARAMETERS OF SEPARATING CONVEYOR OPERATION ON GRAIN CLEANING QUALITY / ВПЛИВ ОСНОВНИХ ПАРАМЕТРІВ РОБОТИ ТРАНСПОРТЕРА-СЕПАРАТОРА НА ЯКІСТЬ ОЧИЩЕННЯ ЗЕРНА Prof. Ph.D. Eng. Vasytkovskiy Oleksii¹⁾, Lect. Ph.D. Eng. Vasytkovska Kateryna¹⁾, Lect. Ph.D. Eng. Moroz Serhii¹⁾, Prof. Dr. Eng. Sc. Sviren Mykola¹⁾, Dr. Agric. Sc. Storozhyk Larysa²⁾ ¹⁾ Central Ukrainian National Technical University / Ukraine; ²⁾ Institute of Bioenergy Crops and Sugar Beet National Academy of Agricultural Sciences of Ukraine / Ukraine</p>	63
8.	<p>DESIGN AND RESEARCH OF AUTOMATIC ALIGNMENT TEST DEVICE OF SEMI-FEEDING PEANUT COMBINE HARVESTER 半喂入式花生联合收获机自动对行试验装置的设计与研究 Prof. Ph.D. Eng. Lv X.L.^{1,3)}, R. Ph.D. Eng. Hu Z.L.^{*2)}, R.A.M.S. Eng. Wang S.Y.²⁾, R.A.M.S. Eng. Yu Z.Y.²⁾ ¹⁾ Ministry of Agriculture, Key Laboratory of Modern Agricultural Equipment/China ²⁾ Ministry of Agriculture, Nanjing Research Institute for Agricultural Mechanization / China; ³⁾ Chuzhou University, College of Machinery and Automotive Engineering/China</p>	71
9.	<p>DETERMINATION OF ROLLING RADIUS OF SELF-PROPELLED MACHINES' WHEELS / ВИЗНАЧЕННЯ ДІЙСНОГО РАДІУСУ КОЧЕННЯ ТА ОЦІНКА КОВЗАННЯ КОЛІС САМОХІДНИХ МАШИН Prof.PhD.Eng. Golub G.A., Ph.D. Eng. Chuba V.V., Ph.D. Eng. Marus O.A. National University of Life and Environmental Sciences of Ukraine, Kyiv / Ukraine</p>	81

		Page(s)
10.	<p>MATHEMATICAL MODEL FOR THE EVOLUTION OF <i>Chlorella Algae</i> / MODEL MATEMATIC PENTRU EVOLUȚIA ALGELOR CHLORELLA Mat. Cârdeș P.¹⁾, Ph.D. Eng. Nedelcu A.¹⁾, Ph.D. Eng. Ciuperca R.¹⁾</p> <p>¹⁾ National Institute of Research-Development for Machines and Installations Designed to Agriculture and Food Industry - INMA Bucharest / Romania</p>	91
11.	<p>PARAMETER OPTIMISATION AND EXPERIMENT ON THE COMBING OF <i>Cerasus humilis</i> / 钙果梳脱部件参数优化与试验 As.Ph D. Stud. Eng. Xiaobin Du, Prof. Ph.D. Eng. Junlin He*, M.S. Stud. Eng. Yongqiang He, M.S. Stud. Eng. Dawei Fang College of Engineering, Shanxi Agriculture University, Taigu / China</p>	103
12.	<p>PHYSICAL PROTECTION IN EXPERIMENTAL RASPBERRY PLANTATION / ФІЗИЧНИЙ ЗАХИСТ В ЕКСПЕРИМЕНТАЛЬНІЙ ПЛАНТАЦІЇ МАЛИНИ Szalay K.¹⁾, Keller B.¹⁾, Kovács L. ¹⁾, Rák R. ¹⁾, Peterfalvi N.¹⁾, Sillinger F. ²⁾, Golub G.³⁾, Kukharets S.⁴⁾, Souček J.⁵⁾, Jung A.²⁾</p> <p>¹⁾NAIK Institute of Agricultural Engineering / Hungary; ²⁾Szent István University / Hungary; ³⁾ National University of Life and Environmental Sciences of Ukraine / Ukraine; ⁴⁾ Zhytomyr National Agroecological University / Ukraine; ⁵⁾ Research Institute of Agricultural Engineering / Czech Republic</p>	115
13.	<p>DETERMINATION OF INTERACTION PARAMETERS AND GRAIN MATERIAL FLOW MOTION ON SCREW CONVEYOR ELASTIC SECTION SURFACE / ВИЗНАЧЕННЯ ПАРАМЕТРІВ ВЗАЄМОДІЇ ТА РУХУ ПОТОКУ ЗЕРНОВОГО МАТЕРІАЛУ ПО ПОВЕРХНІ ЕЛАСТИЧНОЇ СЕКЦІЇ ШНЕКА Prof. DSc. Eng. Hevko R.B.¹⁾, Ph.D. Eng. Zalutskyi S.Z.²⁾, Assoc. Prof. Ph.D. Eng. Hladyo Y.B.²⁾, Assoc. Prof. Ph.D. Eng. Tkachenko I.G.²⁾, Prof. DSc. Eng. Lyashuk O.L.²⁾, Prof. DSc. Econ. Pavlova O.M.³⁾, Prof. DSc. Econ. Pohrishchuk B.V.¹⁾, Assoc. Prof. Ph.D. Eng. Trokhaniak O.M.⁴⁾, Assoc. Prof. Ph.D. Econ. Dobizha N.V.¹⁾ Ternopil National Economical University / Ukraine; ²⁾Ternopil Ivan Puluj National Technical University / Ukraine; ³⁾Lesya Ukrainka Eastern European National University / Ukraine; ⁴⁾National University of Life and Environmental Sciences of Ukraine / Ukraine</p>	123
14.	<p>DETERMINING THE PARAMETERS OF THE DEVICE FOR INERTIAL REMOVAL OF EXCESS SEED / ВИЗНАЧЕННЯ ПАРАМЕТРІВ ПРИСТРОЮ ДЛЯ ІНЕРЦІЙНОГО ВИДАЛЕННЯ ЗАЙВОГО НАСІННЯ Lect. Ph.D. Eng. Vasylykova K.V.¹⁾, Prof. Ph.D. Eng. Vasylykovskiy O.M.¹⁾, Prof. Dr. Eng. Sc. Sviren M.O. ¹⁾, Lect. Ph.D. Eng. Petrenko D.I. ¹⁾, Prof. Dr. Eng. Sc. Moroz M.M. ²⁾</p> <p>¹⁾ Central Ukrainian National Technical University / Ukraine; ²⁾ Kremenchuk Mykhailo Ostrohradskiy National University / Ukraine</p>	135
15.	<p>EXPERIMENTAL STUDIES ON DRYING CONDITIONS OF GRAIN CROPS WITH HIGH MOISTURE CONTENT IN LOW-PRESSURE ENVIRONMENT / ЕКСПЕРИМЕНТАЛЬНІ ДОСЛІДЖЕННЯ РЕЖИМІВ СУШІННЯ НАСІННЯ ЗЕРНОВИХ КУЛЬТУР ІЗ ВИСОКОЮ ВОЛОГІСТЮ В СЕРЕДОВИЩІ НИЗЬКОГО ТИСКУ Prof. Ph.D. Eng. Rogovskii I.L.¹⁾, Senior lecturer Ph.D. Eng. Titova L.L.¹⁾, Senior lecturer Ph.D. Eng. Trokhaniak V.I.¹⁾, Assoc. Prof. Ph.D. Eng. Solomka O.V.¹⁾, Senior lecturer Ph.D.Eng. Popyk P.S.¹⁾, Ph.D. Eng. Shvidia V.O.²⁾, Ph.D.Eng. Stepanenko S.P.²⁾</p> <p>¹⁾ National University of Life and Environmental Sciences of Ukraine; ²⁾ National Scientific Centre "Institute of Mechanization and Electrification of Agriculture" / Ukraine</p>	141
16.	<p>IMPROVED REMOTE-CONTROL WIRELESS SENSING SYSTEM OF PLANT GROWTH FACTORS IN GREENHOUSE ENVIRONMENT / 远程控制型温室环境植物生长要素无线检测系统 Ph.D. Bin Li¹⁾, Stud. Yuqi Zhang¹⁾, Ph.D. Ying-Nan Kan¹⁾, Prof. Yao-Dan Chi¹⁾, Prof. Xiaotian Yang¹⁾, Ph.D. Jianing Wang²⁾, Prof. Yiding Wang²⁾</p> <p>¹⁾ Institute of Electrical & Computer, Jilin Jianzhu University, Changchun 130012, P.R. China; ²⁾ State Key Laboratory on Integrated Optoelectronics, College of Electronic Science and Engineering, Jilin University</p>	147
17.	<p>RESEARCH OF QUALITY INDICATORS OF WHEAT SEEDS SEPARATED BY PRE-THRESHING DEVICE / ДОСЛІДЖЕННЯ ПОКАЗНИКІВ ЯКОСТІ НАСІННЯ ПШЕНИЦІ ВІДДІЛЕНОГО ПРИСТРОЄМ ПОПЕРЕДНЬОГО ОБМОЛОТУ ЗЕРНА Doctor of technical sciences Sheychenko V.O. ¹⁾, Ph.D. Kuzmych A.Ya. ²⁾, Postgraduate Shevchuk M.V. ²⁾, Ph.D. Shevchuk V.V. ³⁾, Ph.D. Belovod O.I. ¹⁾</p> <p>¹⁾ Poltava State Agrarian Academy / Ukraine; ²⁾ National Scientific Centre "Institute of Agriculture Engineering and Electrification" / Ukraine; ³⁾ Uman National University of Horticulture / Ukraine</p>	157
18.	<p>DESIGN AND CONSTRUCTION OF CHOPPER MACHINE AE02-TYPE FOR OIL PALM FROND / RANCANG BANGUN DAN KONSTRUKSI MESIN PENCACAH TIPE-AE02 UNTUK PELEPAH SAWIT Ph.D. Eng. Ramayanty Bulan¹⁾, Ph.D. Eng. Safrizal¹⁾, Ph.D. Eng. Muhammad Yasar¹⁾, M.Eng. Yudi Nata²⁾, M.Sc. Agustami Sitorus²⁾</p> <p>¹⁾ Department of Agriculture Engineering, Faculty of Agriculture, Syiah Kuala University / Indonesia ²⁾ Department of Mechanical Engineering, Faculty of Engineering, Nusa Putra University / Indonesia</p>	165

		Page(s)
19.	<p>EXPERIMENTAL RESEARCH OF MISCANTHUS PLANTING TECHNOLOGICAL PROCESS BY MEANS OF UPGRADED POTATO PLANTER / ЕКСПЕРИМЕНТАЛЬНЕ ДОСЛІДЖЕННЯ ТЕХНОЛОГІЧНОГО ПРОЦЕСУ САДІННЯ МІСКАНТУСА ЗА ДОПОМОГОЮ КАРТОПЛЕСАДЖАЛКИ Prof. PhD. Adamchuk V. ¹⁾, Prof. PhD. Bulgakov V. ²⁾, PhD. Ivanovs S. ³⁾, PhD. Prsyazhnyi V. ¹⁾, PhD. Boris A. ²⁾ ¹⁾ National Scientific Center "Institute for Agricultural Engineering and Electrification" NAAS of Ukraine, ²⁾ National University of Life and Environmental Sciences of Ukraine / Ukraine ³⁾ Latvia University of Life Sciences and Technologies / Latvia</p>	173
20.	<p>SUBSTANTIATION OF MOTION PARAMETERS OF THE SUBSTRATE PARTICLES IN THE ROTATING DIGESTERS / ОБҐРУНТУВАННЯ ПАРАМЕТРІВ РУХУ ЧАСТИНОК СУБСТРАТУ В МЕТАНТЕНКАХ, ЩО ОБЕРТАЮТЬСЯ Prof. Doctor of Engineering Golub G.A. ¹⁾, Prof. Doctor of Economics Skydan O.V. ²⁾, Doctor of Engineering Kukharets S.M. ²⁾, Ph.D. Eng. Marus O.A. ¹⁾ ¹⁾ National University of Life and Environmental Sciences of Ukraine / Ukraine, ²⁾ Zhytomyr National Agroecological University / Ukraine</p>	179
21.	<p>THE EFFECT OF MASS FLOW RATE OF WHEAT SOLID PARTICLES ON CHARACTERISTICS OF ACOUSTIC SIGNALS IN PNEUMATIC CONVEYING / <i>اثر دبی جرمی ذرات جامد گندم در انتقال نیوماتیکی بر ویژگی‌های سیگنال‌های صوتی</i> Ph.D. Stud. Mehdi Samadi ¹⁾, As Prof. Vahid Rostampour ^{*1)}, Prof. Shamsollah Abdollahpour ²⁾ ¹⁾ Urmia University, Dep. of Mechanical Engineering / Iran; ²⁾ Tabriz University, Dep. of Mechanical Engineering / Iran</p>	187
22.	<p>NECESSITY AND POSSIBLE APPROACHES TO APPLYING DEEP LOOSENING WHEN CULTIVATING RICE / НЕОБХІДНІСТЬ ТА МОЖЛИВІ ПІДХОДИ ДО ЗАСТОСУВАННЯ ГЛИБОКОГО РОЗПУШЕННЯ ПРИ ВИРОЩУВАННІ РИСУ Ph.D. Eng. Lukianchuk O.P. ¹⁾, Prof. Ph.D. Eng. Turcheniuk V.O. ¹⁾, Ph.D. Eng. Prykhodko N.V. ¹⁾, Ph.D. Eng., Volk P.P. ¹⁾, Prof. Ph.D. Eng. Rokochinskiy A.M. ¹⁾, ¹⁾ National University of Water and Environmental Engineering, Rivne / Ukraine</p>	199
23.	<p>INNOVATIVE TECHNOLOGIES OF OILSEED FLAX STRAW MECHANICAL PROCESSING AND QUALITY OF OBTAINED FIBERS / ІННОВАЦІЙНІ ТЕХНОЛОГІЇ МЕХАНІЧНОЇ ПЕРЕРОБКИ СТЕБЕЛ ЛЬОНУ ОЛІЙНОГО ТА ЯКІСТЬ ОДЕРЖАНИХ ВОЛОКОН Prof. Ph.D. Eng. Chursina L. ¹⁾, Prof. Ph.D. Eng. Tikhosova H. ¹⁾, Ph.D. Assoc. prof. Holovenko T. ²⁾, PhD. Assoc. prof. Shovkomud O. ²⁾, PhD. deputy director Kniaziev O. ³⁾, Ph.D., Assoc. prof. Yanyuk T. ⁴⁾ ¹⁾ Kherson National Technical University / Ukraine; ²⁾ Lutsk National Technical University / Ukraine; ³⁾ State enterprise «Research farm «Askaniysky» Askaniyskaya state agricultural research station of the Institute of Irrigated Agriculture of the National Academy of Agrarian Sciences of Ukraine, Kherson / Ukraine; ⁴⁾ National University of Food Technologies, Educational and Scientific Institute of Food Technologies, Kiev / Ukraine</p>	207
24.	<p>FOREST GLOBAL POSITIONING METHOD AND EXPERIMENT BASED ON AGRICULTURAL MACHINERY / 基于农业机械的林木全球定位方法与试验 As. PG. Stud Shuo Li ^{1), 2)}, A.P. Ruili Song ³⁾, Prof. Feng Kang ^{*1), 2)}, Dr. Yaxiong Wang ^{1), 2)} ¹⁾ School of Technology, Beijing Forestry University, Beijing / China; ²⁾ Key Lab of State Forestry and Grassland Administration on Forestry Equipment and Automation, School of Technology, Beijing Forestry University, Beijing / China; ³⁾ Computer Science Department, Hebei Professional College of Political Science and Law, Shijiazhuang / China</p>	215
25.	<p>3D SURFACE DEFECTS RECOGNITION OF LUMBER AND STRAW-BASED PANELS BASED ON STRUCTURE LASER SENSOR SCANNING TECHNOLOGY / <i>基于结构激光传感器扫描技术的木材和秸秆人造板三维表面缺陷识别</i> As. Ph.D. Stud Jianhua Yang ^{1), 2)}, Master Stud Xinyu Zheng ¹⁾, Master Stud Jianping Yao ¹⁾ Prof. Ph.D Jiang Xiao ^{*1)}, Associate Prof. Ph.D Lei Yan ¹⁾ ¹⁾ Beijing Forestry University, Beijing, 100083 / China; ²⁾ Beijing Forestry Machinery Research Institute of the National Forestry and Grassland Administration, Beijing / China</p>	225
26.	<p>RESEARCH ON SUNFLOWER SEEDS DRYING PROCESS IN A MONOLAYER TRAY VIBRATION DRYER BASED ON INFRARED RADIATION / ДОСЛІДЖЕННЯ ПРОЦЕСУ СУШІННЯ ЗЕРНА СОНЯШНИКУ У МОНОШАРОВІЙ ЛОТКОВІЙ ВІБРОСУШАРЦІ НА ОСНОВІ ІНФРАЧЕРВОНОГО ОПРОМІНЕННЯ Prof. PhD. Bandura V., Lect. Ph.D. Mazur V., Lect. Ph.D. Yaroshenko L., Lect. Ph.D. Rubanenko O. Vinnytsia National Agrarian University/Ukraine</p>	233
27.	<p>DESIGN AND EXPERIMENTAL OPTIMIZATION OF CLEANING SYSTEM FOR PEANUT HARVESTER <i>捡拾花生收获机清选系统的设计与试验优化</i> Ph.D. Eng. Wang Shengsheng ^{1,2)}, Prof. Ph.D. Eng. Ji Jiangtao ^{1,2)}, Prof. Ph.D. Eng. Jin Xin ^{1,2)}, Prof. Ph.D. Eng. Geng Lingxin ¹⁾ ¹⁾ Henan University of Science and Technology, College of Agricultural Equipment Engineering / China; ²⁾ Collaborative Innovation Centre of Machinery Equipment Advanced Manufacturing of Henan Province / China</p>	243

		Page(s)
28.	<p>STUDY OF FERTILIZER SPREADER CENTRIFUGAL TYPE UNDER FIELD CONDITIONS / ДОСЛІДЖЕННЯ РОЗКИДАЧА МІНЕРАЛЬНИХ ДОБРІВ ВІДЦЕНТРОВОГО ТИПУ У ПОЛЬОВИХ УМОВАХ</p> <p>Prof. Ph.D. Manag. Kobets A.S.¹⁾, Lect. Ph.D. Eng., Ponomarenko N.A. ¹⁾, Lect.. Ph.D. Eng. Kobets O.M. ¹⁾, Lect.. Ph.D. Eng. Tesliuk H.V. ¹⁾, Prof. Ph.D. Agri.Sci. Kharytonov M.M. ¹⁾, Ass. prof. Ph.D. Eng., Yaropud V.M. ²⁾ ¹⁾Dnipro State Agrarian and Economics University, Faculty of Agrarian Engineering / Ukraine; ²⁾Vinnitsya National Agrarian University, Faculty of Engineering and Technology/Ukraine</p>	253
29.	<p>MODELLING OF SOIL COMPACTION UNDER HEAVY-DUTY TRACTORS / MODELAREA COMPACTĂRII SOLULUI SUB ACȚIUNEA TRACTOARELOR DE MARE PUTERE</p> <p>Prof. Ph.D. Eng. Biriș S.Șt.¹⁾, Lecturer Ph.D. Eng. Ungureanu N.¹⁾, Ph.D. Stud. Eng. Cujbescu D²⁾ ¹⁾Politehnica University of Bucharest, Faculty of Biotechnical Systems Engineering / Romania; ²⁾INMA Bucharest / Romania</p>	261
30.	<p>DESIGN OF SMALL MULTIFUNCTION HYDRAULIC CHASSIS FOR HILLY REGIONS OF SOUTHWEST CHINA / 西南丘陵山区小型多功能全液压底盘的设计</p> <p>Prof. Ph.D. Eng. Lv Xiaorong¹⁾, Prof. Ph.D. Eng. Zhang Lihua¹⁾, Ph.D. Eng. Lv Xiaolian²⁾, M.A. Stud. Eng. Wang Xiao¹⁾ ¹⁾ Sichuan Agricultural University, College of Machinery & Electronics/China; ²⁾ Ministry of Agriculture, Key Laboratory of Modern Agricultural Equipment/China</p>	271
31.	<p>PECULIARITIES OF WILLOW PRODUCTIVITY FORMATION IN THE FIRST YEAR OF GROWING UNDER MECHANICAL WEED CONTROL / ОСОБЛИВОСТІ ФОРМУВАННЯ ПРОДУКТИВНОСТІ ВЕРБИ ЕНЕРГЕТИЧНОЇ ПЕРШОГО РОКУ ВЕГЕТАЦІЇ ЗА МЕХАНІЧНИХ ПРИЙОМІВ КОНТРОЛЮВАННЯ БУР'ЯНІВ</p> <p>D. Agri.Sci. Fuchylo Ya. ¹⁾, Senior res. Ph.D. Makukh Ya. ¹⁾, Senior res. Ph.D. Remeniuk S¹⁾, Senior res. Ph.D. Moshkivska S. ¹⁾, Prof. Ph.D. Agri.Sci. Kharytonov M. ²⁾ ¹⁾Institute of Bioenergy Crops and Sugar Beet NAAS of Ukraine ²⁾Dnipro State Agrarian and Economics University, Faculty of Agrarian Engineering / Ukraine;</p>	279
32.	<p>THERMODYNAMICS OF ANAEROBIC DIGESTION: MECHANISM OF SUPPRESSION ON BIOGAS PRODUCTION DURING ACIDOGENESIS TERMODINAMIKA PADA ANAEROBIK DIGESI: MEKANISME PROSES HAMBATAN PADA PRODUKSI BIOGAS SELAMA FASE ACIDOGENESIS</p> <p>Darwin¹⁾, Ralf Cord-Ruwisch²⁾ ¹⁾ Department of Agricultural Engineering, Syiah Kuala University, Darussalam, Banda Aceh 23111, Indonesia; ²⁾ School of Environmental Engineering, Murdoch University, Perth, Western Australia</p>	287

STUDY OF FERTILIZER SPREADER CENTRIFUGAL TYPE UNDER FIELD CONDITIONS

ДОСЛІДЖЕННЯ РОЗКИДАЧА МІНЕРАЛЬНИХ ДОБРИВ ВІДЦЕНТРОВОГО ТИПУ У ПОЛЬОВИХ УМОВАХ

Prof. Ph.D. Manag. Kobets A.S.¹⁾, Lect. Ph.D. Eng., Ponomarenko N.A. ¹⁾, Lect.. Ph.D. Eng. Kobets O.M. ¹⁾,
Lect.. Ph.D. Eng. Tesliuk H.V. ¹⁾, Prof. Ph.D. Agri.Sci. Kharytonov M.M. ¹⁾, Ass. prof. Ph.D. Eng., Yaropud V.M. ²⁾

¹⁾Dnipro State Agrarian and Economics University, Faculty of Agrarian Engineering / Ukraine;

²⁾Vinnitsya National Agrarian University, Faculty of Engineering and Technology/Ukraine;

Tel: +38-097405010; E-mail: envteam@ukr.net

Keywords: *mineral fertilisers, centrifugal spreader, designed disc, machine.*

ABSTRACT

Methods for researching the effect of direction and force of wind on the result of the uniformity and width of mineral fertilizer application have been proposed. Researches on the experimental sample of centrifugal mineral fertiliser spreader in the field conditions have been made. The proposed rotary working body design, structural features of which enable to improve the dispersion evenness of mineral fertilizer, is presented.

РЕЗЮМЕ

Запропоновано методики дослідження впливу сили та напрямку руху вітру на результат рівномірності і ширини внесення мінеральних добрив. Проведено дослідження на експериментальному зразку відцентрового розкидача мінеральних добрив в польових умовах. Запропоновано відцентровий робочий орган, конструкційні особливості якого дозволяють поліпшити рівномірність розсіювання мінеральних добрив.

INTRODUCTION

The most important source of cultivated crops high yields is the mineral fertilizers use (Lal R., 2008). It is known that the application of granular fertilizers onto arable lands is mainly performed using centrifugal spreaders (Biocca et al., 2013; Tijskens et al., 2008; Kobets et al., 2017a; Kobets et al., 2017b). The effectiveness of mineral fertilizers largely depends on the uniformity of the distribution on the field surface (Nukeshev et al, 2014). Unevenness and instability of application reach 20–40% (Nukeshev et al., 2016) and leads to loss of grain crops (Tekin and Sindir, 2014; Ning et al., 2015). Spinner disc type spreaders simple design and little maintenance requirement made them very popular (Tekin and Sindir, 2013). Study of the working process of these devices is important because this knowledge will allow appropriate adjustment and will lead to achieving the desired distribution rules (Petcu et al., 2015; Dong et al., 2013). It was shown that flows of particles with a larger mean diameter achieve a higher velocity on the disc, causing the distribution patterns to shift to lower angular positions. It was concluded that a smaller average particle size leads to a higher mass discharge flow rate from the hopper (Reumers et al., 2003). Major differences in the quality of the spread pattern deposition can be observed in the field because of difficulties in adjusting the machines (Vilette et al., 2005; Šima et al., 2013). Numerous experiments with fertilizers found that the maximum value of the crop yield under certain conditions corresponds to the optimal dose of fertilizer (Boldea et al., 2015; Andric et al., 2012; Hammad et al., 2012; Nazli et al., 2014). An increase in the dose above the optimum level leads to a decrease in crop growth per unit of fertilizers, and if it is excessive - to a decrease in yield (Vetsch and Randall, 2004; Lošák et al., 2011).

Experimental researches have set the task to study the process of centrifugal mineral fertilizer spreader using an improved working body and compare it with a disc from serial production.

MATERIALS AND METHODS

The program of experimental research was supposed to determine the influence of force and direction of wind on the width of fertilizer spreading and uniformity of distribution over field surface. The fertilizer spreading machines (FSM) were used for tests. FSM - 900, FSM – 0.5 (Ukraine) and JarMet 500 (Poland) were used to compare effectiveness of experimental and serial discs. Machine ROTAFLOW RS-M (Netherlands) was involved separately, for comparison. Field tests were held on fields of three farms, which

are located in the north, east and south of the Dnipropetrovsk region. Experiments were conducted with the following fertilizers: granular superphosphate, sulfuric superphosphate, ammonium nitrate, urea, potassium salt. Quality of mineral fertilizers application was determined in following way. Transverse unevenness and fertilizers separation degree were determined by placing tin sheets (trays) with the size of $0.5 \times 0.5 \times 0.05$ m on the spreading width, 0.5 m apart from each other, in 3 rows, with a 5 m interval between rows. Additional set of trays was arranged to determine the longitudinal unevenness across these three rows, which was equal to half of the spread width (fig.1).



Fig. 1 - Placement of trays on the field to determine the uniformity of fertilizer spreading

Longitudinal and transverse unevenness was determined in 5 passes. Separation degree was estimated in 10 passes of the unit. Variation coefficient during the test was 3-5%. Field tests of JarMet 500 (Poland) with developed working body were held in a motion that was deviated from the progressive movement with the developed working body. Working width and coefficient of heterogeneity were the main indicators of the quality of the machines for applying mineral fertilizers.

The variation characteristic of fertilizer application heterogeneity degree on a centrifugal spreader was obtained before tests. This experiment was held using an upgraded disc (fig. 2).



Fig. 2 - Upgraded centrifugal spreader disc

Variation coefficient of dosing apparatus with an average sample size of 1 kg was 12%. Machine work was performed on equal field areas at the working rate of 250-300 kg/ha. Wind speed on the field was from 1 to 5 m/sec. The research scheme of air flow effect on mineral fertilizers application unevenness is shown in fig. 3. Research methodology of air flow influence allows determining influence of wind speed in laminar mode, which is as close as possible to actual conditions for fertilizer machine. Technological process of mineral fertilizers spreading included the following operations: fertilizers load into spreader, fertilizers

transportation by spreader or by car to a field and fertilizers spreading. Tests were made both on unilateral fertilizers and fertilizer mixtures.

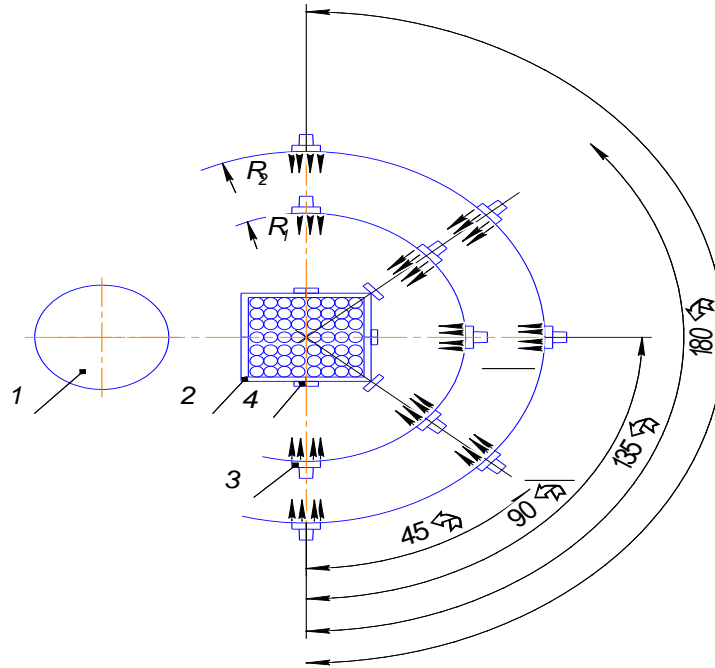


Fig. 3 - Research scheme of air flow effect:

1 – spreader disc; 2 – tray with samplers; 3 – fan; 4 – anemometer

RESULTS

The results of experimental study for centrifugal mineral fertilizer spreader are given in table 1.

Table 1

Parameters of centrifugal mineral fertilizer spreader testing in field experiments

Fertilizer and its humidity		Wind parameters		Rate of application [kg / ha]	Delivery of fertilizers, [kg / s]	Effective spreading width, [m]	Heterogeneity coefficient [%]
		Speed [m / s]	Direction [degree]				
Granular superphosphate	W = 4.8%	1.0	0	250	0.82	14.5	12.9
	W = 4.8%	2.8	0	300	1.73	15.3	15.5
	W = 4.8%	3.0	0	300	1.96	17.0	16.2
	W = 4.8%	2.1	180	300	1.56	13.8	12.5
	W = 4.8%	2.1	90	300	1.49	13.2	14.25
	W = 4.8%	3.1	45	250	0.76	13.4	18.0
	W = 4.8%	2.2	45	300	1.65	14.6	16.0
	W = 4.8%	2.2	135	300	1.53	13.5	16.25
	W = 4.8%	1.0	180	250	0.68	12.1	12.2
	W = 4.8%	3.0	180	300	1.13	10.0	13.9
	Powdered superphosphate, W =16.4%	2.5	0	300	1.79	15.8	-
	Ammonium nitrate, W = 1.3%	2.1	0	250	0.92	16.2	-
	Urea, W = 0.3%	3.4	0	250	1.03	18.1	-
Potassium salt	W = 2.8%	3.0	0	250	0.77	13.6	-
	W = 2.8%	3.0	0	300	1.58	14.0	-
	W = 2.8%	5.5	0	300	1.76	15.6	-
	W = 2.8%	3.0	90	300	1.27	11.2	-
	W = 2.8%	2.4	180	300	1.46	12.9	-
	W = 2.8%	2.4	45	300	1.24	11.0	-
	Mixture of granular superphosphate with ammonium nitrate	2.8	0	300	1.72	15.2	-

It is clear that mineral fertilizer rate does not significantly affect spread width. The most effective width (up to 20 m) is obtained with powdered fertilizer. The effective width reaches 18 m during spreading of granulated and crystalline fertilizers. Less width was fixed when fine crystalline fertilizers were applied. It was found that granular fertilizers with a spreading rate of 10 m/sec were the least affected by the wind. Thus, difference in spreading width with wind, directed at 90° angle to spreading direction (lateral wind) and wind that blows along the spreading direction (passing wind), is more than 12% for granular superphosphate, and 20% - for potassium salt. The increase in the tailwind speed from 1 to 3 m/s contributes to an increase in the effective spreading width of the granular superphosphate by an average of 15%. Results of experimental evaluation of air flow velocity and direction influence on granules distribution are shown in Fig 4.

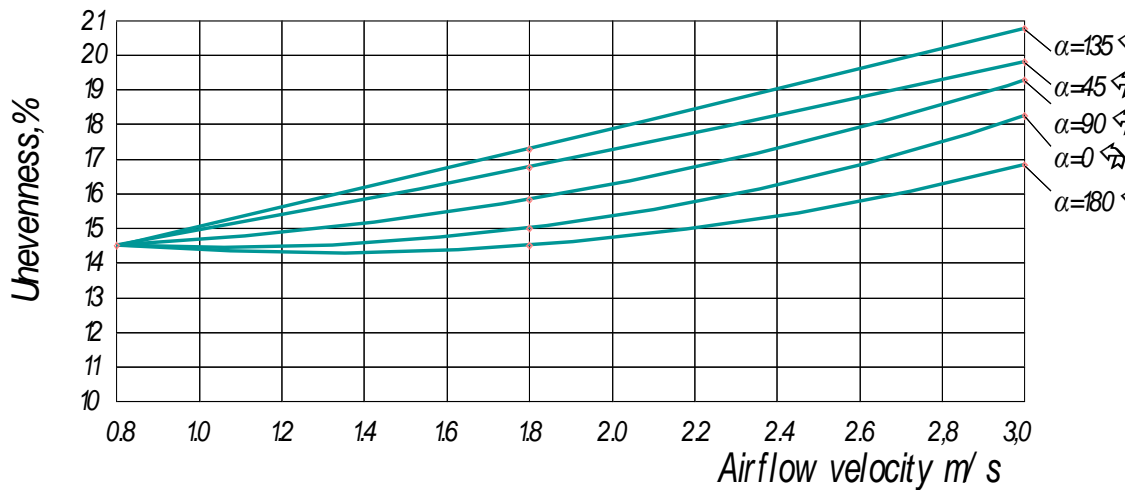


Fig. 4 - Air flow velocity and direction influence on granules distribution

It was established that the wind acting at an angle of 180° to the direction of spreading increases fertilizers separation insignificantly. Side and counter wind, comparing with the action of a passing wind, affects the distribution of particles of fertilizers significantly. Coefficient of heterogeneity increases almost in 2 times. So, fertilizers application at above - mentioned wind directions should be avoided. Fertilizers were applied on an area of 600 hectares during the testing process. Shift productivity reached 55 ha/s (hectare per shift). Quality of fertilizers application met all agrotechnical requirements of the process. Test conditions characteristics: total plot area is 1 ha, field relief is even, microrelief is absent; area inclination - within 2%, type of fertilizer - superphosphate. Presence of wind is up to 2 m/s in opposite direction in relation to machine-tractor unit. Results of determining granules distribution unevenness depending on experimental disc location height above ground level are shown in figure 5.

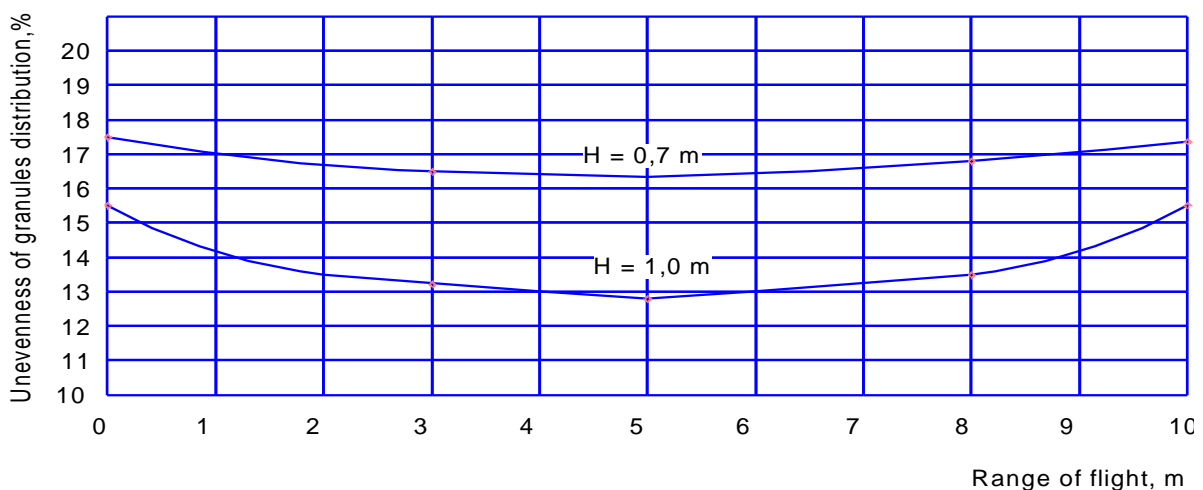


Fig. 5 - Distribution of granules using machine FSM-900 depends on designed disc location height above the ground level and the flight range of granules

The analysis of obtained dependences confirms that uneven distribution of granules is generally satisfactory. It is noteworthy that with the increasing of disc location height above ground level, the unevenness of fertilizer application decreases. This result is due to a longer flight of the particle and, consequently, a longer flow distribution (fig. 6), using machine FSM - 0,5 depending on designed disc location height above the ground level.

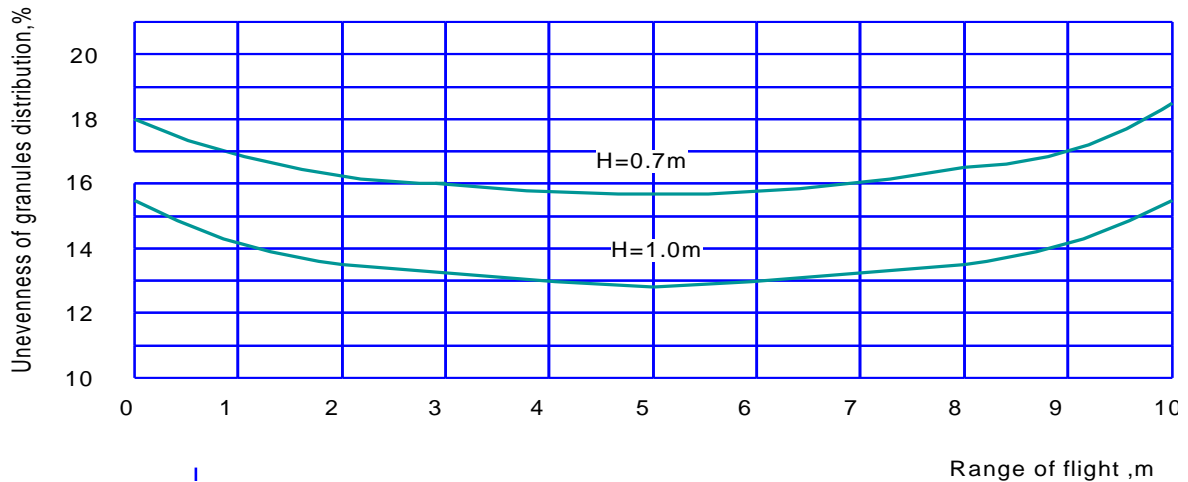


Fig.6 - Distribution of granules depending on designed disc location height above the ground level and the flight range of granules

Results of granules distribution definition for JarMet 500 machine with a designed disc are shown in Fig. 7.

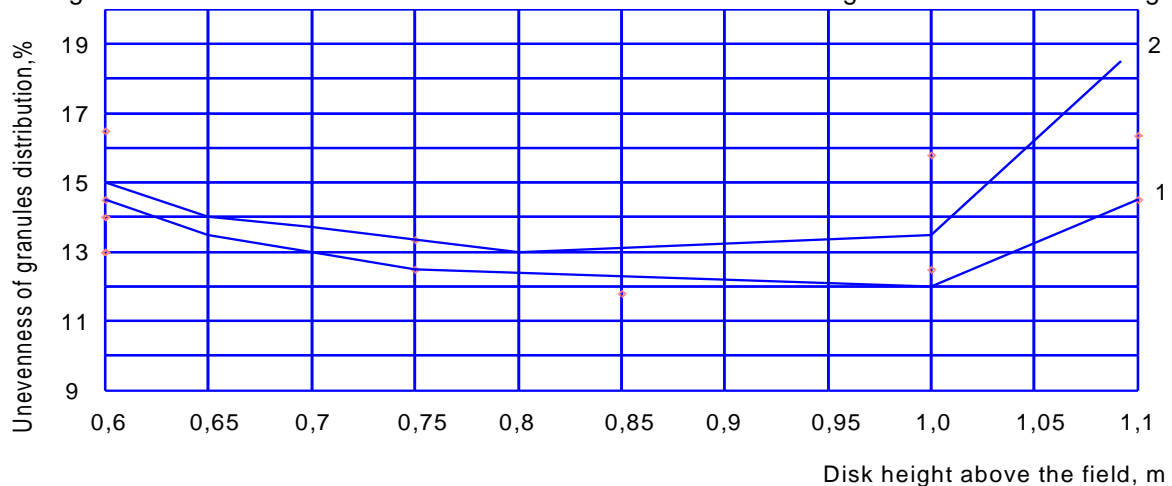


Fig. 7 - Distribution of granules depending on disc height above the field

1 - for steady motion; 2 – deviation from forward motion

After analyzing the obtained dependences, we see that the quality of fertilizer application is influenced by disc location height above ground surface. This applies both to motion deviated from translational with developed working body and steady movement of modernized machine. Thus, fertilizer application uniformity sharply worsens by 5.5 - 6% at the height of 1.1 m. So, optimum disc location height above ground surface level should be considered 1.0 m.

It is obvious that less uniform fertilizer application is observed in single - disc machines FSM-0.5 (Ukraine) and JarMet 500 (Poland). This is due to construction features of the aggregates. Results of determining granules distribution by using the two machines: FSM-0.5 with modernized working body (1) and ROTAFLOW RS-M (2) are shown in Fig. 8.

The machine with serial discs shows unevenness at level of 23-27%, which significantly exceeds indicator of modernized machine, as well as ROTAFLOW RS-M. Uneven distribution with proposed design is less than with the imported one on average by 7-10%.

However, this indicator in ROTAFLOW RS-M is more stable in terms of capture width. Uneven application of mineral fertilizers within limits of agrotechnical requirements does not affect crops harvest and can be considered satisfactory. However, index of a serial machine up to 27% does not meet stated requirements.

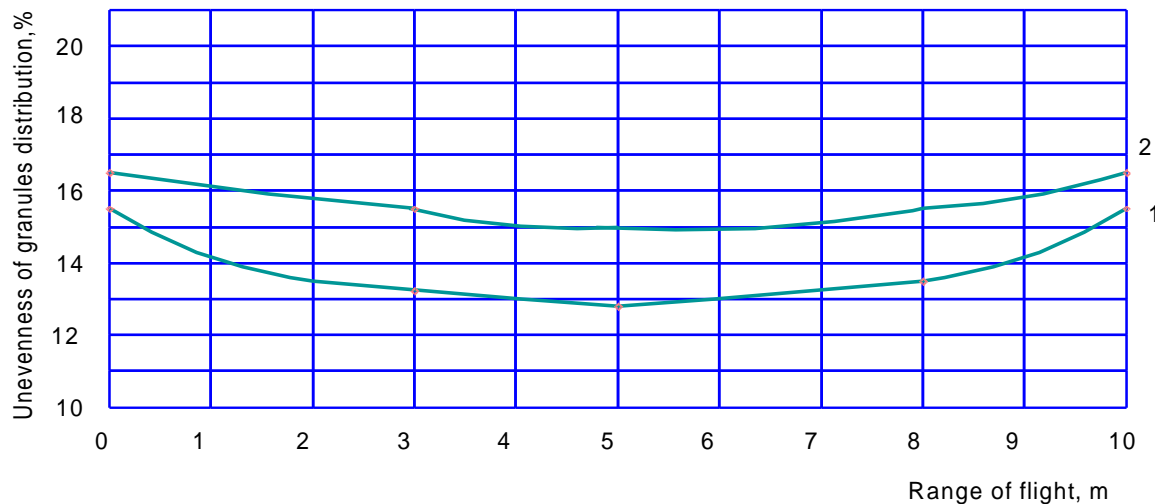


Fig.8. - Distribution of granules depending on designed disc height above the field
 1 - for machine FSM - 0,5; 2 –for machine ROTAFLOW RS-M

Experimental research results made it possible to compare work of centrifugal type mineral fertilizer spreader with disc which was designed and serial disc (Table 2). The unit included Ukrainian tractor MTC-82.1 and machine JarMet 500 (Poland).

Table 2

Performance indicators of centrifugal type mineral fertilizer spreader using designed and serial disc of JarMet 500 machine

Indicator	Basic option	Designed option
Field square [ha]	600	600
Productivity per 1 hour work shift, [ha/hour]	12.20	15.96
Number of operating personnel, [people]	1	1
Fuel consumption, [kg / ha]	0.7	0.5
Shift duration, [hour]	7	7
Unevenness of mineral fertilizer application, [%]	20-35	7-12

Thus, as a result of improvements made to the working body, reduction in unevenness of mineral fertilizers application to admissible standards was achieved. When using the designed option of spreader disc compared to base option, productivity of machine - tractor unit increases by 30.8%, and fuel consumption is reduced by 40%.

CONCLUSION

It is proved that air resistance substantially affects final distribution of fertilizer granules along soil surface. This is mainly due to changes in flight range of individual granules. As a result of research it was established that resistance was not proportional to granule velocity. In range of wind velocities up to 0.5 m/s impact of air flow on granule flight distance did not exceed 5%, which corresponded to an increase of uneven distribution by 0.35%. Influence of other factors on unevenness indicator was much higher. It allowed us to not count wind velocity in calculations in the given range. In this case, estimated uneven fertilizer application was 10.02% for indicated constructive and kinematic indicators at accepted granulometric composition of 1-5 mm.

Mechanical and technological properties of fertilizers, which influenced distribution process the most, were experimentally determined. It was established that mineral fertilizers application rate did not affect spreading width significantly. The most effective width (up to 20 m) was obtained during powdered fertilizer spreading, and when granulated and crystalline fertilizers were applied effective width reached 18 m. The width was smaller when applying fine crystalline fertilizers. It was established that the influence of wind was selective. Air flow directed at an angle from 45 to 135 degrees had the greatest impact on fertilizers uneven distribution by surface. At wind velocity more than 2.0 m/s application qualitative indicators were sharply deteriorated. Comparative field tests proved that the proposed design of centrifugal type spreader ensured fulfilment of agrotechnical requirements for uneven spreading (did not exceed 16%). Uneven spreading was 2 times lower than on serial native spreaders on average and by 7-10% lower than on known foreign analogs. Influence of machine oscillations on this indicator ranges from 5% to 8% of overall unevenness. Implementation of developed recommendations will reduce fertilizer consumption, increase unit's productivity and optimize norms of application.

ACKNOWLEDGEMENT

The work has been funded by the Ukrainian Ministry of Education and Science.

REFERENCES

- [1] Andric L., Rastija, M., Teklic, T., Kovacevic V., (2012), Response of maize and soybeans to liming. *Turkish Journal of Agriculture and Forestry*, 36, pp.415 – 420, Ankara/Turkey;
- [2] Biocca M., Gallo P., Menesatti P., (2013), Aerodynamic properties of six organo-mineral fertiliser particles. *Journal of Agricultural Engineering*; volume XLIV(s2):e83, pp411-41, Milano, Italy;
- [3] Boldea M., Sala F., Rawashdeh H, Luchian D., (2015), Evaluation of agricultural yield in relation to the doses of mineral fertilizers. *Journal of Central European Agriculture*, 16(2), pp.149-161, EU;
- [4] Dong X., Song J., Zhang J., Wang J., (2013), Working performance and experiment on granular fertilizer spreader with cone disc in Nongye Gongcheng Xuebao. *Transactions of the Chinese Society of Agricultural Engineering* 29(19), pp.33-40, China;
- [5] Hammad H. M., Ahmad A., Abbas F., Farhad W., (2012), Optimizing water and nitrogen use for maize production under semiarid conditions. *Turkish Journal of Agriculture and Forestry*, 36, pp.519-532, Ankara/Turkey;
- [6] Kobets A.S., Ponomarenko N.O., Kharytonov M.M.,(2017a), Construction of centrifugal working device for mineral fertilizers spreading. Vol. 51, No. 1. pp.5-14, Bucharest/Romania
- [7] Kobets A.S., Naumenko M.M., Ponomarenko N.O., Kharytonov M.M., Velychko O.P., Yaropud V.M. (2017b), Design substantiation of the three-tier centrifugal type mineral fertilizers spreader. INMATEH – *Agricultural Engineering*. Vol. 53, No. 2, pp.13-20
- [8] Lal R., (2008), Soils and world food security. *Soil and Tillage Research* 102, pp.1-4, Ankara/Turkey ;
- [9] Lošák T., Hlušek J., Martinec J., Jandák J., Szostková M. et al, (2011), Nitrogen fertilization does not affect micronutrient uptake in grain maize (*Zea mays* L.). *Acta Agriculturae Scandinavica Section B: Soil and Plant Science*, 61, pp.543-550, Sweden;
- [10] Nazli R. I., Kuşvuran A., Inal İ., Demirbaş A., Tansi V., (2014), Effects of different organic materials on forage yield and quality of silage maize (*Zea mays* L.). *Turkish Journal of Agriculture and Forestry*, 38, pp.23-31, Ankara/Turkey;
- [11] Ning S., Taosheng X., Liangtu S., Rujing W., & Yuanyuan, W, (2015), Variable rate fertilization system with adjustable active feed-roll length. *International Journal of Agricultural and Biological Engineering*, Vol. 8, Issue 4, pp.19–26, Beijing/ China ;
- [12] Nukeshev S.O., Eskhozhin D., Karaivanov D., Eskhozhin K., (2014), Determination of parameters of the main distributor for fertilizer applying machine. *Bulgarian Journal of Agricultural Science*, 20 (No 6), pp.1513 -1521, Sofia/Bulgaria;
- [13] Nukeshev S., Dzhadyger E., Gennady L., Karaivanov D., Zolotukhin E., Syzdykov D., (2016), Theoretical substantiation of the design of a seeding device for differentiated intra soil application of mineral fertilizers. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*.V.64, №1, pp.115-122, Brno/Czech Republic;

- [14] Petcu A.S., Popa L., Stefan V., Ciuperca R., Nedelcu A., Girleanu I.C., Avramescu A.M., Veringa D., Zaica A., Lazar G., (2015), Theoretical research regarding the working process of the fertilizers managing systems by centrifugation. *Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series*. Vol. XLV, pp.174-184, Craiova/Romania;
- [15] Reumers J, Tijskens E., Ramon H., (2003), "Experimental characterization of the tangential and cylindrical fertiliser distribution pattern from a spinning disc: A parameter study," *Biosystems Engineering* 86(3), pp.327-337, U.K.;
- [16] Šima T., Nozdrovický L., Krupička J., Dubeňová M., Koloman K., (2013), Granulometric study of dasa 26/13 fertiliser. *MENDELNET*, pp.882-887, Brno, Check Republics;
- [17] Tekin A.B., Sındır, K. (2013), Variable Rate Control System Designed For Spinner Disc Fertilizer Spreader – "PreFer". *Journal of Agricultural Engineering*. No: 2, pp.45 – 53, Milano/Italy;
- [18] Tekin A.B., Sındır, K. (2014), Performance assessment of variable rate spinner disc fertilizer spreader – "PreFer". *Agricultural Engineering*. No: 2, pp.43 – 52, Milano/Italy;
- [19] Tijskens E., Van Liedekerke P., Piron E., Van Geyte J., Cointault F., Ramon H., (2008), Recent results of experimental and Dem modeling of centrifugal fertilizer spreading. *Granular Matter journal*, Springer Verlag, 10 (4), pp.247 – 255;
- [20] Vetsch, J. A., Randall, G. W., (2004), Corn production as affected by nitrogen application timing and tillage. *Agronomy Journal*, 96(2), pp.502-509, USA;
- [21] Vilette S., G Cintault F., Piron E., Chopinet B., (2005), Centrifugal spreading an Analytical Model for the Motion of Fertilizer Particles on a spinning disc. *Biosystems Engineering*, 92(2), pp.157-164, U.K.