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Conference proceedings are devoted to theoretical and practical aspects of scientific development in Eastern Europe. General issues of the engineering, medical, psychological, philological, economic sciences, history of art, social communications and so on are considered. The publication is designed for scientists, lecturers, postgraduate students, students, as well as for the general reader.

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# PHYSICAL EDUCATION AND SPORT

#### DEVELOPMENT OF SUMO IN THE WORLD AND IN UKRAINE

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The article discusses the formation and development of sumo wrestling in Japan. The names of the first Sumo fighters are given.

The Ukrainian Sumo Federation was founded in 2001. Thanks to this over the past 27 years, sumo has become a popular sport in Ukraine. Ukrainian amateur athletes are among the strongest in the world, along with the Japanese.

In ancient Japan (III-VI centuries BC), sumo was widely distributed.

The first Sumo fight is a battle between two warriors Naminasukune and Taimanokhaya in Yamato in the Suynin era (30 BC - 70 AD). Naminasukunė won, was deified and became the ancestor of sumo.

In the "Japanese Chronicles" (Nihonsokki) is experienced as Emperor Kogyoku in 642 AD. received the envoy of the country Kudara (the present southern part of the Korean peninsula). He collected the best warriors and arranged a Sumo competition in his honor.

In the early Middle Ages, in the era of Nara (710-794 gg.) Sumo tournaments are arranged in the Imperial Palace. At this time, rituals appear on the special places of the emperor and his entourage, as well as the output of wrestlers and judges. Even then, there was a ritual of division of wrestlers on the left and right (located on both sides of the emperor). Each fighter spent about 20 fights. The fight was conducted on the court, unrestricted and won by the one who threw the opponent on the ground. With equal points, two fighters had an additional fight between them.

The judge (idey) was alone, and if the outcome of the match was doubtful to the emperor, then at his instruction a repeated fight (Torinoxi) was conducted.

At this time, there already existed a tournament ritual and outfits of sumyabit (loincloths of tosagi). Before the opening of the competition, wrestlers on top of the bandages wore a kariginu (ceremonial kimono), on the head – ebosi (pointed headdress of a crow's color). The judge made sure that the wrestlers kept the preparation before the fight, the starting position (nerai) and the restart (sikirinhosi).

In modern sumo, competitions begin to be held regularly since January 1953, four official competitions per year.

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Since January 1985, the first official tournament is held in the new Kokukikan – sumo court in the Ryokoku district of Tokyo.

In November 1988, on the last day of Novybry competitions, Ekodzuna Onokuji stops Ekodzunu Shivonofudzi having won 53 victories in succession.

In September, Ekodzuna Shivonofudzi receives a national award. Then the concept of false start is introduced.

In March 1993, Akebono Taro, the first non-Japanese, was promoted to the rank of ekozuna.

Currently sumo in Japan is both sport and show and the national idea of Spirit-Body.

In Japan, annually hold up to 50 amateur tournaments, as well as the championship of schools, universities, etc.

Of course, a European who does not know the language, customs and traditions of sumo is difficult to understand.

The founder of the Estonian sumo school F. Reinipma in 2001 invited the master of sports S.V. Korobko from Ukraine to participate in the sumo tournament. He became the first sumo player in Ukraine, who took part in European competitions.

The historical roots of the famous Ekodzuna Koki Taiho come from Ukraine, from the Kharkov region, where the Ukrainian Sumo wrestling federation was born in 2001. Over the past 27 years, sumo has become a popular sport in Ukraine and continues to develop intensively.

In the history of sumo, only 69 rikishi (sumotori) managed to rise to the highest level of the wrestling hierarchy. But the record of Taiho Koki has not been beaten by anyone yet. To date, Taiho remains the most titled wrestler sumo -32 won tournaments and 8 of them in a row.

Thanks to hard work on the development of sumo (holding annual national championships, training camps, an annual international tournament with the participation of leading wrestlers in Bulgaria and Poland), the Sumo Federation of Ukraine has a leading position in world sumo. Athletes of Ukraine have repeatedly become champions and prize-winners of peace and Europe of different years, and the national team is a part of world teams – leaders of this sport.

International competitions and amateur tournaments are held in four weight categories: light (up to 85 kg), medium (85-115 kg), heavy (over 115 kg) and absolute (athletes regardless of their weight participate in fights). Women-sumoists have the same categories: light (up to 65 kg), average 65-80 kg), heavy (over 80 kg) and absolute. Amateur competitions are held both in individual and team competitions.

Currently, the strongest sumoists amateur in the world – except for the Japanese themselves – are fighters from Ukraine, Poland, Bulgaria, Mongolia, Brazil.

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### FUNCTIONAL CHANGES IN HEALTH INDICATORS **OF STUDENTS OF HIGHER EDUCATION INSTITUTIONS** IN THE CONTEXT OF MUTUAL TRAINING

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The intensification of the learning process, the use of new teaching technologies, leads to a significant increase in the number of students who are unable to fully adapt to the load (Trout, Lambert, at all 2017). In recent years, the level of individual health of students has deteriorated significantly. There are such adverse trends in the physical development of students as asthenia, decreased chest circumference, decreased lung capacity and muscle strength. In general, only 17% of students have a satisfactory functional body state (Dukh, Lemeshko, 2016). The existing curriculum within the "Physical Education" course is currently unable to solve its most important task - improve the health of students. Therefore, every educational institution, in addition to solving pedagogical tasks, should contribute to the improvement of health and harmonious development of the individual. The outlined issues point to the need of finding new approaches to improving the educational process in physical education.

The results of the orthostatic test characterize the level of adaptation of the circulatory system and heart performance. The assessment has been carried out as follows: the heart rate up to 12 bpm - normal response, indicating to a favorable ratio between the sympathetic and parasympathetic parts of the autonomic nervous system; the heart rate difference by more than 12 bpm - the response is satisfactory, indicating sympathicotonia; the difference greater than 20 bpm - indicated an overload in the heart performance and a weak level of adaptation of the circulatory system.

We have applied the Stange and Hench tests to evaluate the functional state of the cardiovascular and respiratory systems. These techniques can reveal the stability of the human body to combined hypoxia, which reflects the general state of the oxygen supplying systems of the body when breath-holding against the background of a deep breath (Stange) and against a deep exhalation (Hench test). Their results were used to determine the oxygen supply of the body and to assess the overall level of human fitness.

Stange test. The testee took a deep breath and breathed out, then took a breath again (about 80% of the maximum), closed his/her mouth and press his/her nose with the fingers, holding the breath. An excellent indicator for young and healthy people is at least 50 seconds. Hench test. Not less than 40 s is considered an excellent indicator for young and healthy people. The Skibinsky index allows us to assess the functional

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state of the respiratory and cardiovascular systems. The results have been evaluated on a scale: the index less than 5 - very bad, 5 - 9 - bad, 10 - 30 - satisfactory, 30 - 60 - good, more than 60 - very good.

We used the Ruffier test to evaluate the functional state of the cardiovascular system. It consisted in the fact that the student's took 30 sits to stands in 45 seconds. The pulse was measured after a five-minute rest lying 15 seconds before the load (P1), at the beginning of the first (P2) and the second (P3) minutes of recovery. Its value has been evaluated according to the gradation: 3 - high level; 4-5 - above average; 6-10 - average; 11-13 - lower than average; more than 14 - low.

Adaptation potential of the cardiovascular system was calculated according to the R.M. Baevsky method. A certain range of oscillations in the number of points corresponds to each of the four levels of the body adaptation: satisfactory adaptation – <2.1 point; intensive adaptation mechanism – 2.11-3.2 points; unsatisfactory adaptation – 3.21-4.3 points; adaptation failure – 4.31 or more points. The experiment provided for the introduction of learning and teaching cards for the mutual learning of physical exercise techniques by students. Students were involved in mutual analysis of performing exercises; regular self-evaluation and mutual evaluation of personal and group achievements in the process of training was carried out. The microgroups of students were formed depending on the level of development of individual physical qualities. Classes were held in accordance with the study program for the mutual improvement of underdeveloped physical qualities (Dukh, Bodnar, Lemeshko, 2012).

The indicator for EG students has increased by 6.29 RU in the Hench test. The average figures of this test for male corresponded to "satisfactory" estimate. The analysis of Stange test figures shows the improvement of functional capabilities of the respiratory system in EG students. Indicators improved by 10.55 RU from "satisfactory" to "good" grade (p<0.001). A slight increase in reserve capacities has also taken place for male students in the CG, but no statistically significant changes have been confirmed (p>0.05). As a result of the research of Skibinsky test, a probabilistic improvement in the performance of the EG students (p<0.001) has been found. The results corresponded to the satisfactory level of the respiratory system functionality. We have analyzed the level of functioning of the cardiovascular system by orthostatic test and by the Ruffier index. Analyzing the results of the Ruffie test figures in the EG, and between the EG and CG after the experiment, probable changes have been established (p<0.001). The average figures of this index in the students correspond to a satisfactory level of endurance of the cardiovascular system. There have been no statistically significant changes found in the CG students (p>0.05) (Table 1).

At the beginning of the experiment the unsatisfactory level of endurance of the cardiovascular system has been established in 19.4% of students in the EG. After the implementation of the mutual training program, there have been no student with an unsatisfactory grade of the Ruffier index. The results of the orthostatic test of the EG students at the beginning of the experiment in 9.7% of cases showed a satisfactory response of the circulatory system. At the end of the experiment, no individuals with

satisfactory reactions have been found. At the beginning of the experiment in 15.6% of the CG students, the blood circulation system figures corresponded to satisfactory result, and at the end - 9.4%. Indicative programs for the development of physical qualities built on the basis of mutual training had a positive influence on functioning of the cardiovascular system.

Table 1

| Indexes           | Groups | M±SD<br>Before<br>experiment | M±SD<br>after<br>experiment | р           | p<br>between<br>CG i<br>EG |
|-------------------|--------|------------------------------|-----------------------------|-------------|----------------------------|
| Haraha taat       | CG     | 32.72±3.82                   | 34.72±5.57                  | > 0.05      | < 0.001                    |
| Hencha test       | EG     | 31.61±4.84                   | 37.90±2.74                  | < 0.001     |                            |
| Stongo toot       | CG     | 49.44±60.77                  | 51.22±9.39                  | > 0.05      | < 0.001                    |
| Stange test       | EG     | $48.03 \pm 8.65$             | 58.58±4.45                  | < 0.001     | < 0.001                    |
| Skibinsky index   | CG     | $22.96 \pm 4.58$             | 24.75±5.37                  | > 0.05      | < 0.001                    |
| Skibilisky liidex | EG     | $22.98 \pm 5.80$             | 32.57±3.87                  | < 0.001     | < 0.001                    |
| Orthostatic test  | CG     | 7.19±3.95                    | 7.13±3.59                   | > 0.05      | < 0.01                     |
| Orthostatic test  | EG     | $7.10 \pm 3.72$              | 4.87±1.75                   | < 0.01      | < 0.01                     |
| Booysky index     | CG     | $1.84{\pm}0.26$              | $1.79\pm0.21$               | < 0.001     | < 0.001                    |
| Daevsky muex      | EG     | $1.86\pm0.22$                | 1.73±0.15                   | < 0.001     | < 0.001                    |
| Ruffier index     | CG     | $8.68 \pm 2.07$              | 8.33±1.93                   | $\geq 0.05$ | < 0.001                    |
|                   | EG     | $8.58 \pm 2.07$              | 6.43±1.42                   | < 0001      | < 0.001                    |

### Functional changes in health indicators of students

Summing up, it should be emphasized that the program of mutual training of students, developed by us, influenced to the greatest extent on functioning of the respiratory and cardiovascular system indicators, which is reflected in the likely differences between EG and CG. In the course of the experiment, probable changes (p<0.001) in the figures of Ruffier, Hench, Stange tests and the Skibinsky index have been found in the EG students. The number of students with the exertion of the adaptation mechanisms of the cardiovascular system after the experiment decreased by 22.5% (p<0.01). The growth of the rates of the Ruffier index for EG students makes 2.15 RU.

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#### **ARRANGEMENT OF STUDENTS' PHYSICAL TRAINING DURING THEIR OUT-OF-CLASS ACTIVITIES**

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In the recent years, scientists accentuate their attention at cultural functions of education in general, and, in particular, at educational and pedagogical process in regular schools. Scientific ideas underlining that the final result of education is the high level of personal culture; where a modernized education should foster active creators of a general society culture, are becoming more vital. It is stated that the XXI century school in Ukraine should create favorable conditions for every child to master the basic elements of culture.

Modern science attributes the following types of culture itself to the basic elements of a personal culture: legal, economic, political, ecological, artistic and aesthetic, physical, domestic, etc. [1; 5]. Therefore, physical culture is an integral component of a general personal culture. It is natural that "the Concept of National Education" considers student's physical personal culture (integrated with other types) as one of the constituents of the general goal of national education [4]. Strengthening of cultural tendencies in education process requires respective scientific and pedagogical arguments regarding a series of problems in physical training sphere, including education of students' physical training as their personal qualities, as well as an integrated cultural phenomenon.

State approach to the problems of physical training, physical culture and sport is reflected in the Law of Ukraine "On Physical Culture and Sport", "State National Program "Education" (Ukraine of the XXI Century)", "Concept of Physical Education in the Educational System of Ukraine", "Target Complex Program "Physical Education is Health of the Nation". In the context of raising students' physical culture, the main concept of the aforementioned documents is that the physical education of children and youth is considered as an important component of humanitarian education and of a comprehensive development of a young generation.

Many authors study the problematic issues of students' physical culture and education in their works. In particular, they analyze organizational and methodical

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basis of physical and sport activities with students, pedagogical conditions for improvement of the regular schools students' physical culture and education, student's personal development in line with both physical and aesthetic education (L. Hurman, O. Leonov, T. Palagniuk, T. Roters, et al.); cultivating of students' healthy lifestyle, preventing from bad habits by means of physical training (O. Dubogai, S. Zakopailo, V. Kuzmenko, et al.). The authors also study issues of formation of students' positive attitude towards physical exercises and sport, needs of the children with impaired health for physical perfection, conscious discipline by means of physical and recreative activities (O. Zvaryshchuk, V. Lesyk, A. Svatiev, et al.).

The analysis of modern scientific and pedagogical sources, as well as of practice of physical education in regular schools provides with the grounds to confirm that the student's physical culture as an integrated and complex phenomenon and as the student's personal quality has been studied not enough. Underestimation or narrowed understanding of the cultural vector of physical education has a negative impact on management functions, technology of physical education, engaging subjects of school activity into the physical training process, and its efficiency.

To substantiate the specific features of raising of students' physical culture during their out-of-class activities.

A series of following factors influence the process of raising of students' physical culture as the component of their general cultural development: economic, personnel, pedagogical (methodical, managerial), scientific, etc. One of the factor is the pedagogical validity of the concept of "student's physical culture" as an integrated phenomenon (not only as separate acts). We believe the last is substantial since:

a) without revealing the said concept, out-of-class practical activities of a series of subjects that focus at raising students' physical culture (who are not experts) does not contain enough scientific and pedagogical benchmarks. In addition, these subjects (teachers, class teachers, tutors of school clubs and societies) are not motivated to participate in the process of students' physical education;

b) physical culture as a general culture phenomenon even nowadays is often underestimated; sometimes the scope of its cultural impact grows more narrow.

We believe that "a student's physical culture is an ensemble of integrated physical and mental qualities that characterize age-related and individual level of his/her progress in physical efficiency, physical evolution, and physical education. It is also an integral part of a personal general culture and overall harmonic development".

The concept of "a student's physical culture" as a complex and integrated phenomenon leaves its imprint on the technology of its education in regular schools. Level of students' physical culture is deliberately raised via special organized form of learning and out-of-class activities [2, p. 55].

Out-of-class activities give broad opportunities for raising students' physical culture, but only if they are organized on scientific grounds and under favorable conditions for its creative realization. Out-of-class activities provide for students' diversified knowledge about physical culture and sport, broader circle of information sources, students' enriched information awareness on physical training and sport. Moreover, it gives a platform to satisfy individual requirements, and children needs,

to strengthen their motor activity, physical qualities and capabilities. Students start forming their convictions, value benchmarks regarding their own health and its enforcement via physical culture and sport means, healthy way of life, interesting leisure, where physical, recreative and sport activities take a special place. Students form a habit to regularly take part in mass and group forms of physical education.

This age occupies a specific place in a student's development, and psychological and pedagogical literature comprehensively explores the said issue [2; 4; 5]. The main point is that this age is the age of transition from the childhood to grown-ups, when students form personal value benchmarks, make a choice of life samples, use norms and requirements governing in an adult world (positive or negative). From the one hand, this age provides for favorable opportunities to form a student's personality, to perform his/her socialization (assimilation of social positive experience and society norms). From the other hand, this age is a complex controversial period of the student's personal formation, when his/her self-assertion may acquire negative asocial forms and manifestations of consciousness and behavior, due to influence of different factors (lack of experience, negative environment, instability, non-adequate methods and lack of appropriate educational conditions, etc.) Therefore, it is important that a teenager during the period of an active formation of his/her convictions, judgements, knowledge, and attitude towards surrounding world be engaged in positively forming types of activities. It is also important that his/her interests be adequate and in line with a social positive scope of values, as well as certain life samples and positive examples, etc. contribute to forming the said values. Physical culture and sport as a cultural phenomenon, in this context provide for substantial educational opportunities that the school should activate.

Out-of-class activities offer a broad platform for using different forms and means of influence on students' consciousness, feelings and will during the process of physical education, with the aim to deliberately use them for raising a level of physical culture [1, p. 4].

The school administration ensures the overall management of the process of physical culture education, informs the school staff about the state laws, decrees, and decisions of a regional level, that concern physical education issues. It also ensures establishment of a required educational and material basis for sport and physical training classes, provides with assistance in holding out-of-class activities to different subjects of educational and pedagogical process, motivate students to do sports and physical exercises via means of rewarding, coordinates the activities of different physical culture subjects, etc. [5, p. 26].

The teacher of physical training as a high profile professional forms a basis of physical culture by means of all form of educational and out-of-class activities. He/She also informs the student on the modes to master required knowledge, skills and capabilities; methodology of physical abilities improvement in order to strengthen health, ensuring a healthy lifestyle, and active employment. Together with the headmaster (or his/her deputies), the teacher makes working plans on physical education at school; ensures holding of physical training classes; directly administers

in terms of organization and methodology out-of-class activities with the focus at physical and recreative, as well as sport and mass events; ensures school teams participation in city or region competitions, assists other teachers, class teachers, leading and other students.

School medical officers (a doctor, a nurse) directly examine students' health conditions, hold necessary preventive and wellness activities, promote health maintaining and strengthening among students, consult students, teachers, parents, etc. [2, p. 54].

School psychologist, social teacher, holds different events targeted at exploring the level of students' education and politeness, develop required working materials to diagnose the following: level of interest, understanding of the concept of "a healthy lifestyle", attitude towards smoking, taking drugs, leisure planning, etc.

Class teacher has a broad scope of functions in terms of raising students' physical culture; he/she is one of the main subjects to raise it during out-of-class activities [3, p. 30].

The activity of all the subjects of raising students' physical culture should be formed as a common activity. It should be governed by the common goal with every subject to realize his/her functions in order to reach this goal. School administration, teachers, and students should interact in common coordination.

Conclusions. 1. Raising students' physical culture should be based upon modern scientific and pedagogical ground that reflect new (democratic, national, cultural) tendencies in the sphere of education, integration of pedagogical knowledge in pedagogy, psychology, culture, theory and methodology of physical training, necessity in cultural approach in physical education.

2. Learning principles, developed by didactics, should also be used during raising the physical culture level. It is connected with the fact that student's physical culture in its content, has the following components: knowledge, consciousness, etc. Specific scientific and methodological principles are employed as well; they concern the process of educating students to make physical exercises, motor movements etc.

3. Regular school has a wide variety of opportunities for raising students' physical culture during out-of-class activities that become practicable if it is organized on scientific grounds and under required conditions. Every subject of a pedagogical activity should be definitely engaged into the said process, not only the teacher of physical training.

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### FEATURES OF MASTERING THE PROGRAM MATERIAL CONTENT BY FUTURE PHYSICAL EDUCATION SPECIALISTS

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The process of mastering the content of the program material by future specialists of physical culture is complex, contradictory and multi-phased. On the basis of the analysis of psychological and pedagogical researches of certain aspects of control and analytical competence of physical education teachers, our own theoretical search it was revealed that professional knowledge serves as the basis for the highest form of human knowledge – professional speech and thinking. In this context, the mastering of the program material content includes:

- mastering of the conceptual-terminology subsystem of professional disciplines;

- vocational and terminological literacy in oral and written speech;

- ability to conduct conversation, persuade, prove, admire ideas and plans, that is to solve communication problems in situations of professional communication.

However, without taking into account all the nuances of worldview and pedagogical aspects, selecting and optimizing the mastering of the program material content through its logical structuring, it is impossible to manage rationally the development of the investigated competence of physical education teachers.

The purposeful mastering of the program material content by students actually links the goals, program material content, teaching, learning, educational microenvironment, which ensures the integrity of the implementation of control and analytical competence of physical education teachers. According to the results of the theoretical analysis of the problem, it can be approved that the mastering of the content of the program material should be regulated by general didactic principles (scientific knowledge, conscious learning, systematic and consistent learning, the strength of knowledge acquisition, an individual approach to students), as well as the

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specific principles of learning (interdisciplinarity, orientation to future professional activity).

It should be noted that the principle of scientific knowledge envisages enriching the vocabulary of students with professional vocabulary, which is related to the scientific style of speech and term creation. The science of learning consists in the mastering of the adequate content of each term and semantic distinction by students, in correct scientific explanation and mastering the methods of terminology.

Implementation of the conscious learning principle of program material involves the construction of experimental techniques based on the unity of speech development, language and thinking, words and concepts, scientific concepts and terms. The processes of conscious studying the terms directly interfere with the influence of various factors on the formation of speech skills and also such skills, where under interference the violation of one language norm under the influence of another language norm is understood. In this case, as a rule, the external interference (the influence of other languages) and internal (the effect of similar elements on each other within the same language) is distinguished. Apart from that, the interference at the level of speech and language level is differentiated :

- a random similar coincidence in the sound of the concept of foreign-language origin and Ukrainian, which do not have a common origin (yes, in such a way or e.g., instead of "bilirubin" – from lat. Bilirubin – yellow pigment – they write "bilorubin", instead of "iron-defeciency" – "iron deficiency");

- a random coincidence in the sound with another notion of foreign origin (the interchange of the termoelement of the neuro (Greek: neuron – the nerve) and the nephro – (Greek: nephros – the kidney).

It is clear that such coincidences may lead to an incorrect, distorted understanding of the professional term semantics. This type of error may be due to the incorrect morpheme classification, which is the most complicated, since it requires a fairly thorough knowledge of the classical languages. During the investigation, we discovered that quite a large number of students do not know the semantics of professional terms and terminology of foreign origin. Only a conscious approach (and the mechanical learning of terms is difficult to say) can prevent errors. For this purpose, it is proposed to clarify the etymology (origin) of a professional term, to establish its foreign language etymon, to define semantics, and to divide it into morphemes.

The principle of systematic and sequential learning is conditioned by the logic of science and the peculiarities of the cognitive activity of students of physical culture disciplines. It is important for them to use the terms not isolated from each other, but in a complex. This should be taken into account in the texts of exercises, in which it is necessary to submit the material on the basis of semantic, lexical-grammatical, word-building and stylistic features.

As a result of scientific research, a specific norm is distinguished, the observance of which facilitates optimization of the mastering of the program material content by future specialists of physical culture through its logical structuring. Thus, the principle of interdisciplinarity of all professional knowledge gained during the study of general

and vocational training disciplines provides their systematization [1], which would aim to teach and educate competent professionals. Note that till today, in the domestic theory and methodology of education management there was not produced or ... the domestic theory didn't produce ... an unified view of interpersonal relations. Some scholars interpret them as a didactic principle (M. Levin, N. Loshkarev, V. Maksimov, S. Rashkov), others as didactic (V. Khomutsky, V. Fedorov, V. Maksimov, A. Usov, M. Cherkes-Zade) or pedagogical (F. Sokolov) condition.

From the review of the scientific and pedagogical literature [4; 5], it is known that interpersonal relationships are classified by the type of knowledge and by the type of activity. At the level of knowledge, they are revealed through language, theory or applied part. The implementation of such links at the level of activities is achieved through a variety of learning methods and organizational forms. Based on totality of the structure of educational subjects and the structure of the educational process, some scholars distinguish content-information, operational-activity and organizational-methodical connections. It is not coincidentally, that according to V. Semichenko, "each academic discipline forms the future specialists' professional qualities of the three levels of integration: intro-subject (knowledge, skills and skills that make up the specifics of a particular field of science), inter-subject (interdisciplinary, formed by a common cause-consequential influence of the complexes of educational disciplines) and metasubject (integrative qualities that are formed as a result of the influence of the whole system of vocational training)" [5, p. 40].

The principle of orientation to future professional activities provides mastering the knowledge, competencies and skills necessary for a future specialist since the first lessons. This principle is revealed in the fact that the mastering of the program material content is conditioned by the vital need, an attempt to continuously improve the student's speech, enriching their vocabulary depending on the specialization of the preparation [2, p. 17]. In this way, the mastering of the program material content in the course of educational activities is gradually transformed into a professional one, passing a number of transitional forms. Such logic of training future specialists provides the implementation of physical education teachers control and analytical competence for the thorough mastering of students theoretical vocational and terminological knowledge, the formation of practical skills and skills during the logical structuring of the content of the program material.

Modern professional training of future physical culture spesialists is characterized by improvement of curricula, programs, qualification standards and training itself. It should be noted that the issues of selection and structuring of the program material contents, which is studied at the faculties of physical culture, were studied by A. Demin, P. Luzan, V. Manko, I. Palamar, S. Daukilas [3; 4] and other scholars. In their works the principles of selection and optimization of the mastering of the program material content are substantiated, the knowledge, abilities and skills which the future specialist must possess are analyzed and the approaches to logical structuring and presentation of this material are revealed [2]. Taking into account the requirements of the present, with selecting and structuring of the program material content, researchers turn to the activity approach [2; 3], focusing on the professional activity of a future specialist through the selection of professionally directed educational information and a set of tasks and exercises that maximally cover all elements of future professional activities.

So, selecting and structuring the program material one should take into account the relevant principles and criteria.

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#### SWIMMING AS A WAY OF PHYSICAL DEVELOPMENT OF THE STUDENT

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Swimming refers to cyclic sports and used as a way of physical development of a student in a higher educational institution. Swimming has a versatile effect on the human body, develops endurance and improves mobility in the joints – the health effect on the musculoskeletal system, such a health effect is very useful for a young student's body. Wide dissemination of swimming exercises within the framework of physical education of a student helps to increase the functional capabilities of the body and provides workability during the study.

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The main problem of student youth in recent years is the deterioration of health and physical fitness [5]. The deficit of motor activity inhibits their normal physical development and threatens health. The number of students who have deteriorated the activity of different systems of the organism and the number of students with chronic diseases has increased, etc. Therefore, the formation of an installation for physical education and selected sports is an important aspect of physical development of students [6].

Physical development is a process of formation and subsequent change during the life of morphofunctional properties of the student's body [1] and it is based on physical qualities and abilities, the development of which can be carried out through various sports, for example, swimming.

Physical development of students during a swimming class is characterized by changes in the following indicators [3]:

1. Indices of physique (length and weight of the body, posture, volume and shape of individual parts of the body, size of fatty tissue), which characterize primarily biological forms or morphology of the organism.

2. Indicators of development of physical qualities (endurance).

3. Swimming is one of the most important parts of the complex rehabilitation of the body.

The purpose of the study is the characteristic of swimming as a means of physical development of the student during the conduct of training sessions with physical education.

Methods of study included analysis of literary sources.

The health effects of swimming on the body has a positive effect on the main indicators of physical development: growth, weight, life capacity of the lungs. Swimming is an excellent way of preventing and correcting postures, scoliosis, strengthening the cardiovascular and nervous system, the development of the respiratory apparatus and the muscular system, and contributes to the growth and strengthening of bone tissue [2].

It is commonly used to correct the disturbances of posture and deformation of the spine – different types and degrees of scoliosis, lordosis, kyphosis, stitchiness.

The healing therapeutic properties of swimming are shown in the positive change in physiological parameters in students with respiratory failure, which contributes to their elimination [4]. Decrease of the function of external respiration accompany acute and chronic respiratory system diseases and manifest respiratory failure, which is manifested by violation of processes of oxygen saturation and removal of carbon dioxide from it. Insufficiency of external breathing arises as a result of a violation of pulmonary ventilation, disturbances of diffusion of gases, inconsistency between ventilation and blood circulation in certain areas of the lungs. Swimming activities help to strengthen the tone and increase the strength of the respiratory muscles and also have a beneficial effect on the process of blood circulation and enhance ventilation of the lungs. Greater energy consumption contributes to the greater need for oxygen, so the squirrel tends to use every breath with maximum completeness. Water pressure on the thoracic cavity contributes to a more complete exhalation and at the same time contributes to the development of the muscles that extend the chest. It leads to an increase in the vital capacity of the lungs and to the improvement of the functional capabilities of the respiratory system.

Small and medium values of physical activity in water affects processes in gastrointestinal tract and also positively changes in the central nervous system which are expressed in improving their adaptation. In addition, the performance of movements in the aquatic environment affects the training of vestibular stability and the function of body balance.

Swimming is an excellent way of tempering, forming and developing hygienic skills. Hardening is based on the ability of an organism to adapt to changing environmental conditions. Systematic swimming exercises increase the adaptive capacity of the body to the adverse effects of temperature fluctuations and high humidity. The water temperature is always below the temperature of the human body, therefore, when human body located in water it emits 50-80% more heat than in the air (water has a thermal conductivity of 30 times and a heat capacity of 4 times more than air). Thus, the protective reaction of the organism to cold water irritation is a reflex enhancement of heat production. Under the influence of cold and cool water there is a spasm of small vessels of the skin, there is an outflow of blood to the internal organs and reduced heat loss. The narrowing of the skin vessels increases the resistance to blood flow, which causes more and more cardiac contraction, some increase in blood pressure.

The cold effect of water leads to a disturbance of the nervous system:

1) the first phase of the reaction – the skin becomes pale and cold to the touch, chills appear;

2) the second phase of the reaction – the narrowed skin vessels expand, the muscle wall tone increases and blood flow is accelerated, the blood flow from the internal organs to the skin occurs. It leads to the loss of heat by the body and causes an increase in the metabolism, which requires more oxygen consumption, that is, intensifying the work cardiovascularly vascular and respiratory systems, the skin becomes pink and warm to the touch, it causes a pleasant feeling of warmth.

3) third, undesirable, reaction phase – with prolonged exposure to cold water, blood vessels remain dilated, the tonus of their walls decreases, blood flow is slowed down, venous stasis develops, the skin becomes bluish-red and cold to the touch, a "goose skin" is formed, a secondary chills appear: the appearance These signs indicate the need for immediate outflow of water.

Studying of swimming within is not only about the development of special motor qualities, but also about the formation in their process of the mental, emotional and emotional sphere, the positive impact of psychomotor development on the intelligence and hardening of the body.

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#### SUSTAINABLE MANAGEMENT IN SPORT

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Sport, in all its forms and activities, influence an environment. Additionally, sport is also interwoven in culture and society and the sports industry can use unique influence to provide much-needed business leadership in ecology and sustainable practices. The tangible effects of sports organizations environmental actions as to Casper J. M., Pfahl M. E. (2015) can help in supporting public health, reducing pollution, protecting habitats, saving energy and water, environmental behavior change in sport fans' lives, and far beyond. These effects have initiated a sport environmental movement with two broad goals: to reduce the ecological footprint of sports activities and to exploit the popularity of sports to raise environmental awareness in general [1, p. 3].

Power of sport, as one of the important drivers of promoting sustainable development, is supported by the results of numerous scientific research in ecology, management and economics. Many organizations from governmental, public, and business sectors pay attention to sports, as a tool capable of making a positive contribution to overcoming the most acute challenges of humanity, such as strengthening peace, protecting the environment, protecting human rights and freedoms.

As it was stated in 2030 Agenda for Sustainable Development, sport is also an important enabler of sustainable development. We recognize the growing contribution of sport to the realization of development and peace in its promotion of tolerance and respect and the contributions it makes to the empowerment of women and of young people, individuals and communities as well as to health, education and social inclusion objectives [2, p. 10].

Ensuring a balance between the nature opportunities and the needs of sports organizations has determined the necessity of implementation of the environmental management in 1980<sup>th</sup> that is also based on sustainable development principles [3, p. 54].

A concept of sustainable development appeared in the 1970s in the frames of environmental protection and prevention of the ecological problems, which were

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caused by rapid growth of population, ineffective industrial management, increased transport systems, uncontrolled and excessive use of natural resources. Sustainable development has been defined in many ways, but the most frequently quoted definition is from *Our Common Future*, also known as the Brundtland Report: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [4].

The challenges came along with such mega sport events as the Games of the Olympiad and Winter Olympic Games, Youth Olympics, World and European Championships, World Universiades were considered in the same perspective. To host Games, plan and maintain huge infrastructure of numerous sports and public facilities, organize accommodation, catering and social program for a large number of athletes, journalists and visitors the implementation of a sustainable management is necessary.

Sustainable development is a holistic concept that includes the idea of planetary boundaries, which, if exceeded, could cause irreversible damage to natural systems, along with the social and economic issues of human rights and minimum standards for living; in between the two is a space where humankind can continue to develop without abusing the environment. As a management concept, sustainable development balances environmental, social, and economic aspects in decision-making processes. The other factor of vital importance in defining sustainable development is time; our management actions now must project far into the future [5, p. 17].

Sustainable management in sport (SMeS) is the approach that allows ensuring environmental safety, social benefits and profitability of a sports organization based on the sustainable development. Growing environmental concerns, coupled with public pressure and stricter regulations, are changing the way sport do business across the world. Sport is on a three-stage journey from ecological management, through environmental risk management; to long-term sustainable development strategies (see Figure 1).

The following fundamental principles could be applied to the SMeS:

(1) The economic efficiency as the ability of using nature and human resources for sports industry with the positive feedback for environment and society (line X at Figure 1).

(2) The environmental footprint as the priority of environmental objectives while hosting sports events, maintaining sports facilities and managing sports industry (line Y at Figure 1).

(3) The social imperative as the priority of human needs in safe environment and high standards of living and engaging in sports activities (line Z at Figure 1).

In the initial phase of the journey, the need to comply with environmental regulations drives improvements in eco-management. Sport businesses adopt a more proactive approach in the next phase. Environmental risk management is introduced, to reduce environmental liabilities and to minimize the costs of regulatory compliance.

Some sport organizations recognize that the implementation of sustainable business strategies can lead to new opportunities and improved results – the sustainable management phase.



Figure 1. Homology field of sustainable management in sport

Today's sport sector is increasingly emphasizing the concept of sustainability and incorporating a triangle of economic, environmental and social approaches when making management decisions about legacy and development. As sports organizations all over the world face the challenges of sustainability, there is an increasing need for leaders who have the capacity to incorporate strategies for both sustainability and profitability into their businesses to achieve value maximization in a more holistic way. With environmental issues such as global warming, pollution and the depletion of natural resources threatening our existence, sports organizations must learn to reduce, reuse and recycle in order to protect our planet while taking care of people and maximizing outcomes. Sustainable management in sport is a brand new approach that looks beyond short-term profits, and focuses on long-term gain by incorporating the environmental and social costs of doing business into strategic management plan.

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### **BIOLOGICAL SCIENCES**

### BIOECOLOGICAL FEATURES OF GROWTH AND DEVELOPMENT OF HAZELNUT (*CORYLUS DOMESTICA* KOSENKO ET OPALKO) PLANTS IN THE CONDITIONS OF THE RIGHT-BANK FOREST-STEPPE ZONE OF UKRAINE

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The ability of plants to adapt to changing growing conditions manifests itself in the nature of the passing of phenological phases. The study of the seasonal development of hazelnut plants is necessary for understanding the plant growth in the specific conditions of this zone in order to develop agrotechnical measures for planting care, to find the best time for harvesting nuts, and to determine the dates for protecting plantations from pests and diseases. Therefore, to determine the features of adaptation of hazelnut plant varieties to the conditions of the area of introduction, seasonal rhythms of growth and development were investigated. As a result of phenological observations in the Right-Bank Forest-Steppe Zone of Ukraine, the following seasonal phenological phases of plants of *Corylus* L. varieties were noted: the beginning of the vegetation and the dormancy. These seasonal rhythms of plant development are included in the complex of the most important bioecological and economic and biological indicators characterizing the degree of compliance of new climatic conditions with the natural requirements of introduced varieties.

The seasonal rhythms of plant organisms (changes in their phenophases) are an integral indicator of adaptation and reflect the ecological response to changes in environmental factors that affect directly or indirectly the plant [7, p. 23]. Therefore, the phenophases can be used to predict the outcome of an introduction experiment, to describe the adaptive states of introducents. And systematic description of the complex of phenological phases is relevant for the formation of the theoretical foundations of plant adaptation to changes in the conditions of existence that occur under introduction. The generalization of individual changes in plant organisms and their subsequent incorporation into a single logically grounded theory of adaptation is a long-term strategy for obtaining fundamental solutions [8, p. 54].

It is known that reliable data for analyzing the adaptive properties of plants, that is, assessing their potential for introduction, can be obtained by visual field methods,

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which include phenological observations. And the dates of passage of the main phenological phases by plants reflect the level of their adaptation to the environment. So, the analysis of phenological rhythms is an important tool for the study of the ecology and biology of individuals and populations [5, p. 136].

Hazelnut is originated from the Mediterranean subtropics, and for the agroecological conditions of the Right-Bank Forest-Steppe Zone of Ukraine, it is an introducent for which the soil-climatic conditions are quite favorable.

The most important exogenous factors influencing plant organisms, along with the solar energy, should also include temperature and humidity. Therefore, in our experiments, we focused on temperature as a factor influencing changes in the phenophases of the objects under research.

The temperature value is determined primarily by the fact that it determines the rate of chemical reactions in living organisms. For organisms, there is a temperature optimum for the realization of both certain chemical processes and for the very existence [1, p. 173]. This results from the ecological valence of the organisms. Outside of the temperature optimum, the oppression of all vital functions comes [2, p. 158]. So, the growth of hazelnut shoots begins at the transition of average daily temperatures through +10 °C only, and the length of the growth period is 60–75 days [3, p. 226, 4, p. 59].

An organism with a wide amplitude of ecological valence to the action of the temperature factor (typical of eurybionts, in particular, from temperate climatic zones) is better adapted to changing conditions, which can manifest itself in the absence of specific reactions to temperature changes.

From the point of view of identifying potential introducents to the Forest-Steppe Zone of Ukraine, it can be assumed that phenological studies will reveal the most promising ones among the studied varieties that come from different climatic regions. For example, the variety Futkurami is of Georgian selection. Potentially, data should be found that will indicate that it is less adaptive than the varieties of local selection and, consequently, less productive.

Sudden temperature gradients are the so-called "disturbing" factor, that is, a stress factor. In terms of its presence, it is possible to find organisms that are characterized by lower nonspecific resistance – or lower ecological valency – that is, their lower ability to maintain homeostasis (this is about such a property of biological systems with any levels of their organization as self-organization) [6, p. 121].

Since, as noted above, the temperature determines the rate of chemical reactions in living organisms, therefore, its sharp gradients should be reflected in a number of parameters that depend on the adaptive capabilities of the organism (or the level of its nonspecific resistance, or ecological valence). In our studies, this is the period of the duration of the phenophase growth and development of hazelnut varieties. Phenological observations will indirectly indicate the hazelnut varieties that are most promising for the agro-ecological conditions of Ukraine.

The study of the seasonal development of the studied varieties of hazelnuts is necessary for understanding the plant growth in the specific conditions of this zone in order to develop agrotechnical measures for planting care, to find the best terms for harvesting fruits (nuts), to determine the dates for protecting plantings from pests and diseases, etc.

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### MOLECULAR GENETIC ANALYSIS OF VARIABILITY OF *HA*, *NA* AND *NP* GENES OF *INFLUENZA VIRUS* (COMPARED TO H1N1 AND H7N9 STRAINS)

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Virus Influenza virus (the genus Orthomyxoviridae) is an avian influenza agent – an acute highly contagious disease of the respiratory and gastrointestinal tract [1, p. 12]. According to polymorphism, the nucleotide and amino acid sequences of Influenza virus are divided into three types: A, B and C. The most common zoonotic agent is a type A virus that is able to overcome the interspecific barrier and affect birds and mammals, including humans [2, p. 24; 3, p. 41]. Type A virus has the largest number of HBs among the Influenza virus. Such properties of this virus are due to the higher speed of its evolution than those of type B and C [1, p. 5; 3, p. 78]. Periodically, Influenza A causes epizootics, epidemics and pandemics [3, p. 66]. In recent years, due to mass epizootics in more than 50 countries, the forced slaughter of millions of heads of birds was carried out [4, p. 12; 5, p. 4]. The most important factors in the virulence of the avian influenza virus are surface proteins hemagglutinin (HA, or H) and neurominidase (NA or N), and a replication factor of a nucleoprotein (NP). Polymorphism of these genetic data remains insufficiently investigated [6, p. 58; 7, p. 98; 8, p. 43]. Influenza virusA is divided into subtypes according to the polymorphism of NA and NA. There are 18 NA (H) and 11 NA (N) subtypes. Epizootics are largely due to the highly virulent strains of H1N1 and H7N9 [2, p. 52]. The aim of the study was to investigate the variability of HA, NA and NP genuses of avian influenza viruses encoding the virulence factors of HA, NA and NP, respectively, for the H1N1 and H7N9 strains. The research material used was nucleotide sequences of the HA, NA and NP gene of the avian influenza virus strains H1N1 and H7N9, obtained from the National Center for Biotechnology Information (National Center for Biotechnology Information). Cluster analysis and genetic sequencing of HA, NA and NP gene sequences were performed using the MEGA 6 program using the ClustalW algorithm. The dendrograms were constructed using a (UnweightedPairclustering method with arithmetic averaging pairwise GroupMethod), the reliability was counted using bootstrap analysis with the number of replicates equal to 500. The result was found to be greater than 70. Validity of the HA, NA and NP genes was investigated by local alignment of the selected sequences using the Smith-Waterman algorithm using the Vector NTI-11 program. Polymorphic locus was determined on the longest nucleotide sequences of the corresponding genes. Numbers on nodes is an indicator of bootstrap analysis. On the X-axis - the length of the branches (replacing the position). As a result of the cluster analysis of the sequence of the HA gene for H1N1 and H7N9 strains, separate clusters form. The

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nucleotide sequences of the H1N1 and H7N9 strains of the gene form separate clusters, indicating a high level of polymorphism of this gene. The NA sequence of the H7N9 strain forms a separate cluster, as well as a common cluster with sequences of the H1N1 strain. The nucleotide sequences of the H1N1 strain gene are genetically identical. A portion of the NA nucleotide sequence of the H7N9 strain forms a separate cluster, the other part forming a joint cluster with nucleotide sequences of the NA gene H1N1 strain. The sequence of the NP gene of the H1N1 strain forms a separate cluster, as well as a common cluster with sequences of the H7N9 strain. The nucleotide sequences of the NP genype H7N9 strain and part of the nucleotide sequences of the H1N1 strain are genetically identical. A part of the nucleotide sequence of the NP gene of the H1N1 strain forms a separate cluster, the other part forming a joint cluster with the nucleotide sequences of the NA gene H7N9. Thus, it has been shown that the HA gene of the avian influenza virus has a greater cross-site polymorphism than the NA and NP genes. The polymorphism of the HA gene is higher in the strain of the H1N1 avian influenza virus, the NA gene in H7N9, the NP gene in H1N1. The bootstrap analysis in all cases is greater than 70, indicating the reliability of the results. According to the results of the alignment, the most variable genome is NA, the least variable is NP, which coincides with the result of the cluster analysis. In all cases, the most common polymorphism is single-nucleotide substitution, while the most polymorphic regions are located at the 3 'and 5' ends of the sequences. It is likely that the high variability of the HA gene, and somewhat lower, of NA, causes the ability of the avian influenza virus, in particular its highstrain H1N1 and H7N9 strains, to overcome the interspecific barrier, while the replication factor encoded by the NP genome is less important for overcoming the interspecific bar which determines its lower, versus NA and NA variation.

1. Alignment and cluster analysis of *HA*, *NA* and *NP* genes of avian influenza virus type A.

2. Showing the variability of these genes compared to H1N1 and H7N9 strains.

3. The constructed dendrograms show the degree of variability of the studied genes inside and between strains.

4. The alignment results coincide with the result of a cluster analysis of the nucleotide sequences of the *HA*, *NA* and *NP* genes.

5. The polymorphic sites and the type of polymorphism of the studied genes were determined.

6. The results of the study can be used in the study of phylogeny and molecular evolution

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#### COMPARISON OF SOME CLINICAL PARAMETERS OF BLOOD OF PERSONS WITH VARYING DEGREES OF ACQUIRED MYOPIA

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The research has established that under the myopia, which is considered the most common abnormality of refraction on the planet [1], there are changes in many somatic and functional systems of the human body, in the circulatory system in particular [2-4]. It is known that changes in blood composition are a sensitive marker that reflects the effects of various exogenous and endogenous factors. Therefore, fluctuations in the total number of cell fractions or the shift in the ratio of formed elements can characterize the adaptive-compensatory reserves, the human immune status and reflect the state of its health in general [5-6].

Purpose: to investigate the differences in some indicators of blood count in people with a different (low, medium, high) degree of acquired form of myopia.

In the study after obtaining Informed consent were included 90 volunteers aged 18-35 years, divided according to the degree of development of myopia in 3 groups: 1 - people with the low degree of myopia (up to -3 diopters), 2 - people with the moderate degree of myopia (-3 to -6 diopters), and 3 - people with the high degree of myopia (from -6 diopters). The diagnosis "acquired myopia" and its degree of manifestation was established of the basis of a doctor's conclusion after the annual medical examination.

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Quantitative hemogram values were investigated on a hemoneal analyzer. The leukogram was counted by the methods of light microscopy in the smears of peripheral blood stained by the Romanovsky-Giemsa [7]. The blood parameters, which were studied: the total amount of leukocytes, erythrocytes, platelets, hemoglobin, hematocrit, thrombocyte, erythrocyte (mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, RBC distribution width, RDW CV) and platelets indexes (average platelet count, coefficient large platelets, relative width of platelet distribution).

Blood sampling was performed in the morning before eating with the observance of the medical and bioethical norms [8]. Obtained digital data were processed mathematically by using standard software packages (Microsoft Office Excel 2010, Statistica 6,0).

Results and discussion. All volunteers were analyzed for samples of peripheral blood in order to identify the features of general-clinical indicators, depending on the degree of development of acquired myopia. The comparison was conducted from the level of the average group indicator, established for persons with low myopia.

According to the results, the absolute amount in peripheral blood white blood cells (WBC) among people with moderate myopia is higher by 9.5 %, and among people with high myopia – less by 2.3 % (compared with a weak degree of myopia).

In the group of persons with moderate degree of myopia, there were no statistically significant differences in the number of red blood cells (RBC), RBC distribution width (RDW), mean corpuscular volume of erythrocytes (average RBC size, or MCV), in terms of relative redistribution volume (RDW CV) a tendency to increase values (by 1.8 %) was noted. Under the high degree of myopia, all of the above indicators are characterized by lower values (by 3.6 %, 2.2 %, 3.2 %, 3.4 %, respectively).

Hematocrit (HCT) in the group of persons with moderate degree of myopia was higher (by 1.8%), in the group of people with a high degree – lower by 6.6% (in comparison with the data of persons with low myopia).

The hemoglobin content (HGB) in the blood of persons with moderate degree of myopia was slightly higher (by 1.5 %), than in the group of volunteers with low myopia, and with a high degree, on the contrary, the lower (by 4.8 %). Among persons with moderate myopia, the average hemoglobin amount in the erythrocyte (mean corpuscular hemoglobin, or MCH) was not statistically different from that of patients with low myopia, and the mean concentration of hemoglobin in erythrocyte (MCHC) was lower (by 1.8 %). In the case of high myopia, the opposite trend was noted: the MCHC score did not differ from the mean-group values of persons with low myopia and MCH was lower by 1.8 %.

It should be noted that all of the studied platelet indexes in subjects with moderate degree of myopia were lower than the comparison group (the low degree of myopia): the total platelet count (PLT) – by 6 %, the average volume of platelets (MPV) – by 2.7 %, the large platelet count (P-LCR) – by 9.8 %, the relative platelet distribution width (P-RDW) – by 2.8 %. Under the high degree of myopia, we found an increase

PLT by 2.5 %, a decrease MPV by 4.5 % and P-LCR by 12.7 %, a slight increase RDW by 1.2 %.

The value of platelet crit (PCT) in people with moderate myopia was less (by 9.3%) to a greater extent than in people with high myopia (by 3%) (compared to the low degree of myopia).

Thus, as a result of the our study, it was found that although the parameters studied were within the age range, but differences in clinical parameters of blood in patients with varying degrees of acquired myopia were revealed. The data obtained are of scientific interest and require for further research.

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# **MEDICAL SCIENCES**

### NEUROIMMUNOLOGICAL STATUS IN PATIENTS **OF THE NEUROLOGICAL DEPARTMENT CAUSED BY STRESS**

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In conditions of long-term stress, people are more likely to become dependent on various psychoactive substances, including alcohol and drugs. The purpose of this work was to detect the association of pathological changes in clinical, biochemical and neuroimmunological parameters of patients with mental disorders, complicated by craniocerebral traumas, alcohol and drug intoxication or poisoning under the influence of a stressful condition and the prognosis of the course of the disease [1, p. 72-73]. Methods of investigation: determination of glucose concentration, bilirubin, total protein, transaminases, prothrombin time, fibrinogen, activated thromboplastintime, hemoglobin, leukocytes, counting of leukocyte formula, S-100B protein by the method of immunoassay analysis. Previous studies have shown that the microglia is sensitive to stress, as evidenced by increased activation responses to further immune threat [1, p. 74]. Recently, studies on the level of neuro-specific markers in the patient's cerebrospinal fluid and blood have been performed to improve the diagnosis of brain lesions. Thus, an increase in the levels of neuropspecific enzymes (NSE), major myelin proteins (MDIs), glial fibrillary acidic proteins (GFAPs) and S-100B proteins are estimated. The results of studies indicate that immuno-enzyme screening of neuro-specific proteins allows us to assess the degree of damage to the central nervous system and the depth of pathological changes occurring in the nervous system [2, p. 45]. Determination of the level of S-100B protein in the cerebrospinal fluid in patients with pathology of the brain can confirm the degree of damage to the blood-brain barrier, the possibility of its reproduction, as a consequence, to predict the course of the disease. Serum S100B protein levels have been thoroughly studied in several conditions for damage to the nervous tissue, but not with alcohol addiction. Patients from the neurological department were involved in the study, which in turn were burdened with craniocerebral traumas, alcohol and drug poisoning, which were treated at the Emergency hospital in Kamianske. The patients were divided into three groups. The first one involved patients with craniocerebral trauma - 10 people. The second group consisted of patients in the state of alcohol or drug poisoning -5. To the last third group included

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patients with complex mental disorders – 12 people. The total number was 27 people. All patients were examined in acute time when they arrived at the hospital and in the dynamics. Samples of venous blood and urine were received from all patients. In the whole blood, studies were conducted on the general analysis of blood, glucose, ethanol. In serum, studies were conducted on bilirubin, transaminases, and total protein. The plasma of the blood was a study of prothrombin time, activated partial thromboplastin time, fibrinogen. Drug tests were performed in urine specimens [3, p. 89]. In the group of patients with severe alcohol and drug poisoning, changes in clinical and biochemical parameters were more significant. The study of the level of protein S-100B in serum was conducted on the basis of the Department of Biochemistry and Physiology at Oles Hochar Dnipro National University. The content of serum protein S-100B was determined by the inhibitory immune method enzyme assay (ELISA) [2, p. 47]. The testing was carried out in 96-well polystyrene tablets (Nunc, Denmark) with reagents from one manufacturer ("Sigma", USA): monospecific polyclonal antibodies against S-100B protein, purified S-100B as a standard, and antibodies against Ig G rabbits labeled with horseradish peroxidase. To evaluate the results, the optical density was measured on the Anthos 2010 (Finland) spectrometer at a wavelength of 492 nm. The venous blood was immediately centrifuged after collection and the resulting serum was frozen in a freezing chamber at -40°C until analysis. Serum samples were subjected to a single defrost immediately prior to the study [4, p. 30].

According to the obtained results, it was found that the highest levels of protein were observed in the second group of patients with alcohol or narcotic poisoning: the mean value =  $0.121 \ \mu g \ / ml$ , in the first group: mean =  $0.119 \ \mu g \ / ml$ . Patients in the third group had an inflated amount of S100B in comparison with the control value of conditionally healthy people (0 to 0.07  $\mu g \ / ml$ ), but less than the previous groups of patients (Figure 1).



**Figure 1. Variability of S100B in the studied groups** 

It was showed a significant increase in the transaminases of all the examined patients: in patients with craniocerebral trauma in 40% of cases, in patients with
poisoning – 60%, in neurological patients – an increase in ALT in 65%, and AST in 35% of cases. Glucose levels were elevated in all patients with craniocerebral trauma and poisoning – 100%. This group also demonstrated deviations in the contraction system, and hemoglobin in 20% of cases. In the blood of patients of all groups alcohol was detected: in the group of patients with craniocerebral traumas in 50% of cases, in patients with poisoning – in 60%, in neurological patients – in 41%. Drugs were observed in urine in 20% of cases in patients with craniocerebral trauma, in 40% of patients with poisoning, in 25% of cases in patients with neurological disorders.

The obtained data confirms that not only craniocerebral injuries directly but also alcohol and drugs cause damage to the hepatoto-encephalic barrier of the brain when poisoned with these substances, as evidenced by an increase in the calcium-binding protein S100B in the blood. The results also indicate the effectiveness of the use of neuro-specific S100B proteins for clinical control and base for further investigation.

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# METHOD OF PHYSICAL THERAPY OF PERSONS WHO HAVE SUFFERED A MYOCARDIAL INFARCTION AT THE DISPENSARY-POLYCLINIC STAGE

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The urgency of the research topic is due to the fact that the diseases of the cardiovascular system occupy the first place in the general list of diseases, which often lead to mortality and disability. The need to use physical therapy in a complex recovery is proved by theory and practice.

Persons who have suffered a myocardial infarction, at the dispensary-polyclinic stage of physical therapy, belong to the category of persons suffering from chronic

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ischemic heart disease with post-infarction cardiosclerosis. The tasks of physical therapy at this stage are: restoration of cardiovascular system function by incorporating mechanisms of cardial and extracardial compensation; increased tolerance to physical activity; secondary prevention of coronary heart disease; restoration of work capacity and return to professional work, preservation of restored ability to work; possibility of partial or complete refusal of medicinal preparations; improving the quality of life of the patient.

To prolonged physical activity of patients who have suffered a myocardial infarction, it is allowed to begin 3-4 months after it. According to functional capabilities, which are determined by veloergomagrya, spiroergometry or clinical data, patients are referred to the I-II (strong group), or to the III (weak group) of the functional classes. If classes (group, individual) are conducted under the supervision of the instructor of kinesiotherapy, the medical staff, they are called controlled or partially controlled, conducted at home at an individual plan.

According to the developed method of physical therapy of persons who have suffered a myocardial infarction at the dispensary-polyclinic stage, the course of long-term controlled training is divided into 2 periods: preparatory, duration 2-2,5 months, and basic, duration 9-10 months. The main period is divided into 3 subperiods. In the preparatory period classes are conducted by group method in the hall 3 times a week for 30-60 minutes. The optimal number of people in the group is 12-15 people. In the process of training methodologist should monitor the state of those who are engaged: on external signs of fatigue, on subjective feelings, heart rate, respiratory frequency and more. With positive responses to these loads, patients are transferred to the main period that lasts 9-10 months. It consists of three stages.

The first phase of the main period lasts 2-2,5 months. The lessons at this stage include:

- exercises in the training regime with the number of repetitions of individual exercises to 6-8 times, performed at an average pace;

- complicated walking (on socks, heels, on the inner and outer sides of the foot for 15-20 seconds);

- dosed walking at an average pace in the introductory and final parts of the classroom; at a fast pace (120 steps per minute), twice in the main part (4 minutes);

- to subsidize running at a rate of 120-130 steps per minute or complicated walking ("skiing step", walking with a high knee lift for 1 minute);

- training on bicycle with a dose load of time (5-10 minutes) and power (75% of the individual threshold power);

- elements of sports games.

The heart rate during the loads may be 55-60% of the threshold in the functional group III (weak group) and 65-70% in the persons of the I-II functional classes (the "strong group"). In this case, the peak of the heart rate can reach 135 beats per minute, with fluctuations from 120 to 155 beats per minute.

During exercise, the frequency of cardiac contractions such as "plateau" can reach 100 105 beats per minute in the weak and 105-110 beats per minute in strong groups. The duration of the load on this pulse is 7-10 minutes.

At the second stage (duration of 5 months) the training program is complicated, complexity and duration of loads increase. The dosage run is used in slow and average pace (up to 3 minutes), work on bicycle ergometer (up to 10 minutes) with a capacity up to 90% of the individual threshold level, playing volleyball through the grid (8-12 minutes) with a ban on jumps and a one-minute rest through Every 4 minutes. The heart rate during loads of the plateau type reaches 75% of the threshold in the weak group and 85% in the strong. The peak in the heart rate reaches 130-140 beats / min. The role of therapeutic exercises diminishes and the value of cyclic exercises and games increases.

At the third stage, which lasts for 3 months, the intensification of loads is not so much due to an increase in "peak" loads, but due to prolongation of the physical activity of the plateau type (up to 15-20 minutes). The heart rate at the peak of the load reaches 135 beats per minute in the weak and 145 in the strong groups; pulse growth at the same time is more than 90% in relation to the heart rate of rest and 95-100% in relation to the threshold heart rate.

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## ANALYSIS OF CARDIOVASCULAR RISK FACTORS BASED ON SCREENING QUESTIONNAIRE DATA

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With the influence of various factors on the body, including psycho-emotional and physical stress the reserve capabilities of the cardiovascular system play a significant role. The cardiovascular system is the most responsive to adverse environmental effects, therefore, it is an indicator of adaptive reactions [1, p. 510].

The effectiveness of preventive measures is largely due to the effectiveness of their conduct, the use of reliable statistical data and their in-depth analysis [2, p. 4].

The study should positively affect the prediction and prevention of cardiology diseases in general, which determines the relevance of this work.

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The goal of our study is to analyze the information on the parameters of the cardiovascular system obtained by the method of Internet screening to determine the risk of cardiovascular disease.

A questionnaire, or a surveys, is one of the main technical methods of research conducting, which allows to obtain structured information in accordance to the planned research sequence, using the regulated procedure "question-answer".

The open responses by name, address, and address are provided to identify respondents. The required for the study list of questions involves getting closed responses for the categories, given bellow.

The open responses by name, address, and address are provided to identify respondents. The required for the investigation list of questions suggests closed responses on the problem categories, given bellow:

- General characteristics;
- Systolic arterial pressure;
- Hereditary and cardiovascular anamnesis;
- The presence of a history of type 2 diabetes;
- Physical activity;
- Smoking (active and passive);
- Use of alcohol;
- Sleep (the number of hours and difficulties associated with sleep);
- Stress (tendency to worry, sadness, irritability);
- Activity (by frequency and nature of activity).

The questionnaire was implemented with Google Forms, a part of the Google Docs office suite, which allows you to create online survey forms [3].

270 respondents both young and adult were interviewed. The results table are given on the figure 1.

|    | G   | J                   | К                      | L                  | Μ                   | N        |  |  |  |
|----|---|---------------------|------------------------|--------------------|---------------------|----------|--|--|--|
| 1  | Систолическое артериалы                       | Физические нагрузки | Курение                | Пассивный курильщи | Алкоголь            | 10. Сон  |  |  |  |
| 2  | CategoryFilter                                | NoFilter            | NoFilter               | NoFilter           | NoFilter            | NoFilter |  |  |  |
| 3  | Менее чем 120 мм рт.ст.                       | Физические нагрузки | Не курю                | Нет                | В среднем 1 дринк е | 7 - 8    |  |  |  |
| 4  | 120 - 129 мм рт.ст.                           | Физические нагрузки | Не курю                | Нет                | В среднем 3 дринка  | 5 - 6    |  |  |  |
| 5  | 120 - 129 мм рт.ст.                           | Сидячий образ жизн  | Не курю                | Да                 | Не пью              | 7 - 8    |  |  |  |
| 6  | Менее чем 120 мм рт.ст.                       | Физические нагрузки | Курю менее 20 сигар    | Да                 | Не пью              | 7 - 8    |  |  |  |
| 7  | Менее чем 120 мм рт.ст.                       | Физические нагрузки | Не курю                | Да                 | Не пью              | 5 - 6    |  |  |  |
| 8  | 120 - 129 мм рт.ст.                           | Физические нагрузки | Не курю                | Нет                | Не пью              | 7 - 8    |  |  |  |
| 9  | Менее чем 120 мм рт.ст.                       | Физические нагрузки | Не курю                | Да                 | Не пью              | 0 - 4    |  |  |  |
| 10 | 120 - 129 мм рт.ст.                           | Физические нагрузки | Не курю                | Нет                | Не пью              | 7 - 8    |  |  |  |
| 11 | 120 - 129 мм рт.ст.                           | Физические нагрузки | Не курю                | Нет                | Потребление 1 раз в | 7 - 8    |  |  |  |
| 12 | Менее чем 120 мм рт.ст.                       | Физические нагрузки | Не курю                | Нет                | Потребление 1 раз в | 5 - 6    |  |  |  |
| 13 | Менее чем 120 мм рт.ст.                       | Физические нагрузки | Не курю                | Да                 | Не пью              | 7 - 8    |  |  |  |
| 14 | 120 - 129 мм рт.ст.                           | Физические нагрузки | Экс-курильщик          | Да                 | Не пью              | 5 - 6    |  |  |  |
| 15 | Менее чем 120 мм рт.ст.                       | Физические нагрузки | Не курю                | Нет                | Потребление 1 раз в | 5 - 6    |  |  |  |
| 16 | 130 - 139 мм рт.ст.                           | Физические нагрузки | Не курю                | Нет                | Не пью              | 7 - 8    |  |  |  |
| 17 | 120 120 MM DT CT                              | Физицоскио цагочаки | KUDIO MOLIOO 20 CIAFAR | Па                 |                     | 5.6      |  |  |  |
|    | + 🔳 Ответы на форму (1) 👻 Сводная таблица 1 👻 |                     |                        |                    |                     |          |  |  |  |

Figure 1. The answer table loaded in Excel

A reference to the form "Questionnaire for the detection of cardiovascular risk factors" («Анкета для виявлення кардіоваскулярних факторів ризику» in the original) is placed on the website of the Ukrainian Association of Prophylactic Medicine (http://uapm.org.ua/uk) as banner. A printed questionnaire was also used.

It is known that in medical research a significant number of observations are qualitative. During to processing qualitative information, categorized variables are used, which are obtained by surveys data on nominal and ranking scales. Nominal scales give the simplest classification of objects. Such variables are often quite sufficient to evaluate the results of research. These include the respondents' answers to questions about sex, the presence of type 2 diabetes, diseases of hereditary and cardiovascular anamnesis, types of physical activity, stress, and how to remove it.

The study also uses more powerful scales – ordinal or rank scales. Unlike nominal, the objects in the ordinal scale are ordered (for example, gradations of sleep duration and systolic pressure, frequency of smoking, drinking alcohol, occurrence of destructive feelings of sadness, depression, hopelessness, apathy, despondency, helplessness, lack of interest in society, anxiety, fear, sudden feelings of panic, embarrassment, feelings of resentment or hostility).

The usage of mathematical analysis tools allows to give a numerical estimation of the phenomena being studied, regardless of their nature. Summary data about the number of objects with the same value give us to obtain different frequency indices.

Preliminary processing of the results presented in Excel spreadsheet processor has allowed to allocate the ratio of the frequency of occurrence of some negative and positive factors of cardiovascular risk.

The obvious problem is the lack of sleep, as 48.1% of the respondents sleep 5-6 hours a day, and 3.7% from 0 to 4 hours, and only 44.1% of respondents reaches the norm of sleep (7-8 hours per day), and 4.1% have a long sleep time. At the same time, 45.5% of the total number of respondents feel insomnia. And another 18.7% have a snoring problem.

The high percentage of non-smokers is positive (73%) and 12.2% of those who dropped smoking. More than half (61.9%) completely refuse alcohol, or 31.9% use a one-time norm in 2 weeks.

The most common factors in stress relief are sports (48.6) and play with home pets (54.8). 26.7% use yoga and meditation. At the same time, a sedentary or rare physical activity less than 1 time per week is noted by 24.2% of respondents, 28.1% performs physical activity on average 1 time per week, 36.7 % of the respondents perform regular physical activity (2-3 times a week).

Every week (about 30.2%) and monthly (about 34.3%), some respondents feel sorrow, depression, hopelessness, apathy, disbelief, helplessness, lack of interest in society, irritation or disorder, insult or hostility towards others, anxiety, fear, sudden panic feelings.

The considered researches show the presence of sufficient informative basis for revealing of factors of cardiovascular систем infringement. Timely assessment of the functional state of the cardiovascular system is able to detect early pathology processes at preclinical stages.

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## PHYSICAL REHABILITATION OF THE MUSCULOSKELETAL SYSTEM FOR SCOLIOSIS

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The XXI century was marked by the century of new technologies, therefore in connection with the advent of the Internet, smartphones, computers and TVs, the modern population is devoting more and more time to gadgets and completely forget about their posture and overall health [1, p. 229, 231]. One of the most pressing problems in world practice is scoliosis, since this disease usually develops in people leading a sedentary lifestyle and those who are overweight, osteoporosis, osteochondrosis, etc. Approximately 80% of young people already have disorders of posture, which, in turn, lead to an increase in the risk of pathology not only of the locomotor system, but also of the main organs and systems (cardiovascular, digestive, respiratory, etc [2, p. 10, 12]. Obviously, the need to apply broad medical and preventive measures to combat the posture disorders takes on social significance. The foregoing assumes the search for new means and forms, effective methods for correcting postural disorders and determined the relevance of the chosen topic.

The purpose of the study is the theoretical substantiation of the method of physical rehabilitation proposed for the correction of disorders of the musculoskeletal system in scoliosis.

The tasks of physical rehabilitation are the creation of favorable biomechanical conditions for optimal interposition of all body biosigns, directional correction of

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existing disorders of the spine, pelvis, feet, the formation and consolidation of proper posture, and the creation of a muscular corset [3, p. 59].

The reason for the formation of scoliosis is the rapid growth of the spine with an underdeveloped muscle corset, the immaturity of the neuromuscular regulation, and hypodynamia. The fact is that the vertical body supports both the skeleton as a whole and a large array of muscles. Then the load is distributed evenly throughout the body. When a person sits down, the supporting muscular corset relaxes and the whole weight of the body passes to the spinal column. Great importance lies in the correct posture during eating and sleeping.

Most of the human movements (especially while working at the table, school desk) are associated with the predominant development of muscles that bend the torso. The muscles straightening the body, in the majority of movements a little involved. Inadequate exercise of these muscles affects the posture. The most common cause of acquired disorders of non-pathological posture is weakness of the trunk muscles, mainly the back and abdominal muscles, and the uneven distribution of "muscle traction" plays a decisive role [3, p. 59, 61, 62].

Early instrumental diagnostics allows for timely differentiated correction of disorders of the musculoskeletal system, which is extremely important. At the same time, complex treatment programs should be as individualized as possible. Therapeutic gymnastics should be aimed at correcting the existing disorders of the musculoskeletal system with the formation of a muscular corset and the creation of the skill of correct posture. Differentiated medical gymnastics is carried out depending on the type of static disorders – against the background of a pelvic bias in the frontal ("oblique" pelvis) and horizontal ("twisted" pelvis) planes [4, pp. 4-7].

Rehabilitation of patients with scoliosis, as most authors believe, is complex. The complex of conservative treatment of scoliosis includes medical gymnastics, massage, therapeutic swimming, orthopedic correction methods (corsetting, gypsum beds, etc.). electrostimulation, sparing motor mode, which provides load limitation on the spine. If necessary, prescribed traditional therapy, medication, diet [5, pp. 66-67].

Solving the problem of disorders of the musculoskeletal system is complicated by the lack of interest in physical culture among most people. Correction of violations of posture requires a specific, strictly regulated use of health-improving physical culture, taking into account the types and degree of spinal deformities. Unfortunately, the content of the correctional programs of university students is mainly of a generalized nature of the impact and does not solve the problems of specific violations of posture.

We have developed the following practical recommendations:

1. In the structure of the session, consistent training of long back muscles and abdominal muscles is necessary.

2. In increasing the static endurance of the muscles of the body is of great importance to the use of effective physical activity, taking into account the functional status of each student.

3. Formation of positive motivation of students assignments in physical education should be based on the interests of certain types of physical activity.

4. When conducting classes in the SMG, it is recommended to pay attention to external signs of fatigue and monitor heart rate at the beginning, at the peak of the load and at the end of the lesson [6, pp. 3-5].

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# INDICATORS OF VELOPHARYNGEAL INSUFFICIENCY AND THEIR INFLUENCE ON THE CHOICE OF TREATMENT METHOD

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Velopharyngeal insufficiency (VPI) after primary operations on the palate ranges from 5% to 45% [2], which is due to the type of cleft, the terms and methods of surgical treatment, the complex of speech therapy correction. To prevent the development of VPI, it is important to choose the tactics of treatment for such children, which requires determining the causes of its development. They are related to the functional capacity of the velopharyngeal complex (VPC), the structural components of which are soft palate, lateral and back of the pharyngeal walls. Study

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VPC components will enable to carry out planning optimal treatment, such as surgery or speech therapy [1; 3].

MRI research was conducted on 15 children after veloplasty and 93 children without pathology aged 5 to 18 years. The most varied indicators of VPC are distinguished, which are divided into 2 groups: anatomical and functional. Functional indicators included the muscles of the VPC and the structural units in which they pass: the ratio of the length of soft palate and the distance from the muscle ligament to the palatine aponeurosis to the posterior pharyngeal wall (Pasavans roller) (VL/VPR), the ratio of the length of the soft palate and the width of the mesopharynx (VL/PhW). The anatomical parameters were based on the morphological dimensions of the VPC – the ratio of the width and depth of the mesopharynx (PhW/PhD) and the ratio of the distance of muscle placement in the soft palate to the width of the mesopharynx (VID/PhW). The survey's results highlight three groups of children after veloplasty. The first included 5 patients after veloplasty, which showed a decrease in the index to 0,7 VL/VPR (N=3,0±0,4), VL/PhW (N=1,7±0,3) and to 0,9 PhW/PhD (N=1,6 $\pm$ 0,3), VID/PhW (N=1,4 $\pm$ 0,2). In 3 of them it is noted that one of the anatomical parameters is saved while another one is reduced. This indicated anatomical changes in the tissues of the VPC, which directly influenced the violation of its functional status, and needed first surgical treatment and, next, speech therapy correction. After carrying out of reveloplastics the increase of all functional indicators was noted (VL/VPR, VL/PhW) to 7,9 (N=3,0 $\pm$ 0,4) and 2,8 (N=1,7 $\pm$ 0,3) in accordance. In the second group, which included 6 children, a varied combination of changes in both functional and anatomical parameters was revealed. Thus, in 2 children there was a decrease VL/VPR to 2,3 (N=3,0±0,4) and PhW/PhD to 0,8 (N=1,6±0,3) in a complex with an increase VL/PhW to 3,0 (N=1,7±0,3), this is indicating a shortened soft palate and an enlarged anatomical depth of the mesopharynx, but compensated by a considerably reduced width of the last one. In 3 children there is a decrease VL/PhW to 1,0 (N=1,7±0,3) in a complex with an increase VL/VPR to 6,1 (N=3,0±0,4) and PhW/PhD to 4,7 (N=1,6±0,3), which corresponds to the expansion of mesopharynx, along with a significant reduction in its anatomical depth. One child had a reduction VL/VPR to 1,1 (N=3,0±0,4) with an increase in other indicators, a different combination of indicators indicated the compensated functional capacity of the tissues of the VPC due to the reduction of the width and depth of the mesopharynx. Such children needed initially speech therapy correction, and in the absence of positive dynamics - reoperation with the restoration of tissues of the VPC. In group 3, which includes 4 children, there is a preservation or enhancement of functional VL/VPR from 3,4 to 6,1 (N=3,0±0,4), VL/PhW from 1,4 to 2,1 (N=1,7±0,3) and anatomical PhW/PhD from 1,8 to 4,7 (N=1,6±0,3), VID/PhW from 1,3 to 3,4 (N=1,4 $\pm$ 0,2) indicators within the norm, indicating the state of the VPC close to the norm, and required only a certain speech therapy correction aimed at restoring the synchronization of muscle work.

Speech therapy correction as a component of complex treatment of the VPI includes work on the formation and development of speech respiration (differentiation of nasal-mouth breathing, training of strength and duration of oral

exhalation), kinetic and kinesthetic oral praxis (orofacial myofunctional gymnastics, vibratory massage), with the use of innovative speech therapy technologies.

Speech therapy work on the development of speech respiration used as a preparatory stage for synchronizing the muscles that take part in speech activity affects the strength of phonemes, speech clarity and smoothness. The education of speech respiration becomes especially important in the context of the problem of wide mesopharyngx and short soft palate in children with VPI. For this purpose in the work on training of speech breathing the following speech therapy technologies were used: breathing simulator Rabir TRI-BALL, "nose flute" and "flying ball" [4, p. 232].

The formation of kinetic and kinesthetic oral praxis was carried out in two directions: passive and active. With indicators of short soft palate VL/VPR<2,6 and VID/PhW<1,2 used both passive and active type of speech therapist work (orofacial myofunctional gymnastics). The passive direction foresees work on the use of speech therapy technologies – vibrating massager Z-Vibe with nozzles ARK's Roller and ARK's Soft Brush Tip [4, p. 232], which contributed to muscle loading, improved blood supply to soft tissues. This type of massage helped the patients to restore the kinetics of their own articulation zones. The active direction was aimed at stretching the muscles, increasing the length m. levator veli palatini, m. tensor veli palatini.

With indicators of wide mesophyrx VL/PhW<1,4 and PhW/PhD<1,3 the main focus of the active direction was aimed at training the muscles of the constrictor of the pharynx. For this purpose, specially selected orofacial myofunctional gymnastics was used. In addition, the vibromassager was used to enhance the nourishing effect of constrictors of the pharynx Z-Vibe with nozzles ARK's Roller, ARK's Probe Tip and ARK's Preefer Tip [4, p. 232].

The proposed set of speech therapies was tested in 15 children with VPI, divided into 3 groups depending on the parameters of VPC. The effectiveness of speech therapist correction was estimated by the degree of nasal phonemes, which was determined by the volume of the nasal air jet (modified nasal tube with built-in ball) and its area (diagnostic nasal mirror). Indicators were recorded before and after correctional speech therapist work. To assess the degree of nasalization were selected back-loud sounds (g, k, h). It is these phonemes that are formed with the complete closure of the root of the tongue and soft palate, and the stream of exhaled air is as strong as possible, which requires synchronized work of constrictors of the larynx. To check the level of nasalization, 5 phrases with varying saturation of back-lingual phonemes were selected. (from one to five repetitions in a phrase). Three levels of nasalization were identified – high, medium and low.

The low level was determined under the condition of repetition of all phrases of the nasal air in the modified nasal tube reaching the level of 0-10 cm, the built-in ball does not rise, and its area on the diagnostic mirror is 1 cm<sup>2</sup>. The average level – the indicators of the nasal tube – 10-20 cm, the built-in ball does not rise, the area – on the diagnostic mirror 2 cm<sup>2</sup>. The high level is the level of nasal air > 20 cm, the built-in ball is raised by 0.5-1 cm upwards, the area is > 3 cm<sup>2</sup> (table 1).

Table 1

| The number of repetitions of | before<br>corrective work |        |       | after corrective work |        |       | Wilcoxon              |
|------------------------------|---------------------------|--------|-------|-----------------------|--------|-------|-----------------------|
| back-lingual                 | high                      | medium | low   | high                  | medium | low   | Biglieu<br>Ranks Test |
| phonemes                     | level                     | level  | level | level                 | level  | level | Kanks 10st            |
| 1 repeat of                  |                           |        |       |                       |        |       |                       |
| selected                     | 4                         | 8      | 3     | 0                     | 1      | 14    | P<0.01                |
| phonemes                     |                           |        |       |                       |        |       |                       |
| 2-3 repeats                  | 6                         | 4      | 5     | 0                     | 9      | 6     | P<0.01                |
| > 4 repetitions              | 8                         | 3      | 4     | 2                     | 8      | 5     | P<0.01                |

## Indicators of the level of nasalization in children with VPI before and after correctional speech therapist work

Conducted speech therapy work showed that most of the high level of nasalization occurred in the second group of children, even with one repeat selected phonemes. In the first group, nasalization was more often diagnosed with 2-3 reps of back-lingual phonemes. The level of nasalization was determined mainly by medium and high. Correctional speech therapist work in the first and second groups was conducted in full, including all the outlined stages. As for the third group, the level of nasalization was noted low with the number of repetitions of back-loud sounds was > 4. With this group, correctional speech therapy work was aimed at strengthening the muscles of constrictors of the pharynx and soft palate. The obtained data confirm the effectiveness of speech therapy work in children with VPI, taking into account the parameters of VPC, namely: VL/VPR, VL/PhW, PhW/PhD and VID/PhW, which confirmed the necessity of cooperation of the speech therapist with the maxillofacial surgeon and the preliminary conduct of MRI for the choice of optimal rehabilitation of such children. With complex reduced indicators VL/VPR<2,6 VL/PhW<1,4 PhW/PhD<1,3 VID/PhW<1,2 a repeated surgical intervention on a soft palate with extension of the last and a myoplasty is necessary, after which – a complete speech therapy correction in full. When reduced VL/VPR<2,6 and VID/PhW<1,2 shows both passive and active type of speech therapy work (orofacial myofunctional gymnastics). With indicators of wide mesophyrinx VL/PhW<1,4 and PhW/PhD<1,3 the main emphasis should be directed to training the muscles of the constrictor of the pharynx. In the case of maintaining or enhancing the functional VL/VPR, VL/PhW and anatomical PhW/PhD, VID/PhW Indicators of rehabilitation of such children are aimed at restoring the synchronization of the work of the muscles of the VPC.

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# PHARMACEUTICAL SCIENCES

## **UPGRADE AND USING WEB 2.0 SERVICE IN STUDY PROCESS OF PHARMACEUTICAL STUDENTS**

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To be in demand in the labor market, you need to navigate and understand many novelties. It's impossible to imagine a person or a future specialist who would not use Skype, a navigator or search systems (services). The motives for personal teacher modernization (for specialists) should be the desire to learn new methods of learning and to increase their knowledge, develop for themselves and keep up with the IT staff. This is especially true for teachers who teach students in higher medical institutions [1; 2, p. 792].

The most common services: - Google Drive provides 15 GB (including e-mail storage) space on your disk; - Dropbox is 2 GB (can be increased up to 16 GB free of charge); - Yandex Disk provides 10 GB free of charge, which can be increased up to 20 GB (also, temporarily, you can use more disk space); - WEB 2.0 is a method of system designing; - Mega is providing free 50 GB of disk space; - Office 365 is a cloud service, which provides a collaborative work of the companies or organizations, with 5 GB of disk space for free on OneDrive.

Recently, more and more services have been created on the Internet, which are built on the WEB 2.0 technology. WEB 2.0 is a method of systems designing. Main idea of WEB 2.0 is getting better with the taking into account network interactions, and the amount of users. The using of social services in study process can contribute to the development of such important skills as critical thinking, collective creativity, and team interaction. Modern Web 2.0 social services open up unlimited horizons for application in educational, professional, personal and social activities, namely: - use of open, free and free digital resources; - independent creation of network educational content; providing and receiving distance consultations; - creation and participation in groups (communities) for preferences; - development of new concepts of the information environment; - gaining new knowledge and developing new skills; - collective creativity and collaborative interaction; - participation in the activities of the network community [3; 4].

To our mind, it is necessary to apply also electronic educational resources from the information support of vocational guidance work of teachers of natural and

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mathematical specialties to obtain professional education and the subsequent selfsufficient work in market conditions, along with traditional methods of vocational guidance.

Increasingly, Internet users prefer small amount of information in different formats and from different sources (blogs, YouTube, Flickr, etc.) instead of reading large volumes of documents. Now due to social services everyone can not only gain access to digital collections, but also participate in the formation of their own network content or join in its cooperative development.

Last time many services have appeared supporting collective work on a joint project. The known example is Google Drive. Taking into account the wide range of functionality, for example, such services as Diigo, YouTube, Google Drive, FreeMind, Blogger, Twitter, FaceBook, LinkedIn, iGoogle, Webinar can be used in career-oriented activities. Diigo is a personal information management system. It is a service storage of the various sites links and links to pieces of text on the site pages. The user can save private or public (they will see everyone) bookmarks. A bookmark is a record that consists of a link to a particular site or a text piece, its title and a brief description. Also, the service allows you to create groups and invite users to them.

The bookmarks of sites on specific topics can be posted in groups. The service can be used for collective work of students with materials for professional orientation: to highlight the main thing, to make bookmarks, and so on. Such services as http://www.bobrdobr.ru – BobrDobr; http://delicious.com/ – Delicious; http://memori.ru/ – Memori also perform the similar functions.

YouTube is a web hosting service. Users can add, view and comment on videos. The service also allows users to recommend videos to others. According to Alexa.com, YouTube is ranked third in number by number of visitors. You can use it to post, search, comment, and distribute video material from your professional orientation.

Google Drive allows users to create, save, edit directly on-line, even without installed office software on the user's computer, view documents on the network and share them with other users. The service supports collective work with documents. Using this service you can create: text documents, tables, presentations, forms (a form with a list of questions and answers – tests), drawings (diagrams, graphs, etc.). With the help of this service, a career advisor can make surveys and tests, organize a collective discussion of a certain material, and so on.

FreeMind or knowledge maps (cognitive maps, mental maps) are schemes in presented with various ideas, tasks, and abstracts are presented, connected with each other and combined by a common idea. The user can structure information in the form of diagrams and provide it to students using this service.

Blogger is a network diary service. Usually blogs are public and involve thirdparty readers who can enter into controversy with the author. But there are private blogs. The content of such blogs can only be seen by the author. The main content of blogs are posts that are regularly added and contain text, images or multimedia. For blogs, short records are sorted in reverse order (last record above). The links to documents, video materials, career guidance sites and other materials can be placed on the blog.

Twitter is the network of microblogging has become a further development of the idea of blogging. You can send messages to the Twitter network using the web interface, client applications or SMS. Thanks to the ease of sending messages and the speed of news distribution, The Twitter is called a new kind of media due to easy massage sending and fast news flash. Even some periodicals have their own representation on this network.

LinkedIn is a social network for finding and establishing business contacts. Contacts can be requested both from the site and from the outside, but LinkedIn requires prior known with the contacts. In the case where the user does not have a direct relation with the contact, he can be represented through another contact (friend of a friend). LinkedIn users can use a contact list for a variety of purposes: to be represented through existing contacts and to expand relations; search for companies, people, interest groups; publish professional resume and search job; recommend and be recommended; publish vacancies; create interest groups.

iGoogle is a service that allows you to create a personalized start page or a personalized Internet portal. The page is organized in tables. Each table contains custom modules. For example, search using Google, RSS streams, weather forecasts in the selected region, bookmarking module, etc. [3].

Webinar (http://webinar.ipo.kpi.ua/) is a platform for conducting web-seminars (webinars). The service provides the opportunity for the leader (moderator, trainer, consultant, teacher) to transfer information, and participants allows receive information and learn with the help of a virtual class that has the ability to hear and see each other wherever you are. Especially important features: participants show presentation, draw on a virtual whiteboard, doing active survey. The members can ask questions in the online chat window for better interactivity. It also can be used: http://wiziq.com – WizIQ, www.comdi.com – Comdi, www.dimdim.com – Dimdim.

Now we are witnessing the rapid development of social media. The question that has to be answered is how to assess the impact of mass services on the goals set using social services to build a personal learning environment? There is a need for collecting and processing statistical information about participants' activities. Statistical reports will help assess the impact of social media on achieving goals. The combined data of WEB analysis and social activity allows you to get a general idea of the content and community activity about it [5, p. 684].

Recently, tools for collecting statistic data from the most famous search engines such as Yandex.Metrics and Google Analytics are very popular. Google Analytics is a free service for keeping detailed statistics about visits to websites from Google. The service allows you to evaluate the traffic of the website and the effectiveness of various marketing activities. It also provides advanced data analysis capabilities, including displaying them in convenient graphs. The service works using HTTPS. Analyst is used by about 49.95% of 1,000,000 leading websites (according to Alexa.com). The free version is limited to 10 million pageviews per month. Users with an active Google AdWords account have the ability to track unlimited number

of pageviews. Currently, Google Analytics has the ability to build 80 types of reports that can be customized. The examples are daily visits (number of visitors per day, week, month, etc.), pageviews, average visit duration, bounce rate (percentage of views for which the page was viewed only), percentage of new visits, types of traffic (source of site referrals), popular search queries with which the user came to the site, the time of staying on the site by country, display of statistics on visits to the world map, activity in social networks (how many visitors of the site shared information in social networks) achieved the target (indicated conversions to the page marked binding site administrator to view it) and so on.

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# THE USE OF LEVOCETIRIZINE IN THE TREATMENT OF ITCHING DERMATITIS

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The development of a treatment strategy for a number of allergic diseases has historically been associated with identifying the role of histamine in the mechanism for the development of allergic symptoms. There are various methods of suppressing the activity of histamine in the body. For example, corticosteroids. Histamine receptor blockers, anti-leukotriene drugs prevent histamine from acting on target cells.

Itching dermatitis include contact dermatitis, eczema and atopic dermatitis. The clinical manifestations of these diseases have a different picture, but the underlying pathogenesis mechanisms are similar. Previously used the term – "neurodermatosis". Now this name is rarely used, although it emphasizes the role of changes in the nervous system and its effect on the occurrence and course of the disease [1].

Itching is one of the leading symptoms of most allergic dermatitis. Combing the surface of the skin leads to increased production and release of pro-inflammatory

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cytokines, which can increase itching and trigger a vicious cycle involving these phenomena [2].

One of the causes of itch is histamine, whiles other mechanisms, central and peripheral, and is still being studied. It is known that serotonin, proteases, such as kallikrein, papain, and peptides – bradykinin, prostaglandins, leukotrienes and Eicosanoids have an itching effect [3].

The problem of treating itching dermatitis remains highly relevant. In the treatment of diseases of this group, the use of antihistamine drugs is the "gold standard". Antihistamine activity is based on the ability to remove the peripheral effects of the mediator of allergy – histamine, and it is in those tissues that are mainly involved in the clinical manifestations of allergy. On the part of the skin, typical manifestations of the action of histamine are a feeling of itching and a blistering – hyperemic reaction. Antihistamines prevent the action of histamine by blocking its H1 receptors. The rapid manifestation of the effect and increase the safety of their medical use – the necessary characteristics of modern anti-histamine drugs [4].

However, the majority of these drugs give a number of adverse side effects, most often in the form of drowsiness, less often – the development of addiction.

That is why there is an increased interest in antihistamine drugs of the new generation, which have high therapeutic efficacy, have a quick and long-lasting effect and do not affect the ability to work, concentration, and coordination of movements.

The drug that meets these characteristics is levocetirizine. This is a new antihistamine and anti allergic drug of the third generation. Levocetirizine blocks H1 - histamine receptors. It prevents development and facilitates the course of allergic reactions, has anti exudative, anti itching and anti inflammatory effects.

High bioavailability, low metabolism, lack of interaction with other drugs – these pharmacokinetic features make Levocetirizine available for the treatment of allergies in all patients. Also, this drug is suitable for the treatment of persons suffering from diseases of the liver and heart, as it does not affect intra cardiac conduction. Levocetirizine begins to act during the first hour in all groups of patients. Proved good tolerability with prolonged use while maintaining high efficiency.

In Ukraine, levocetirizine is used to treat the symptoms of allergic rhinitis and allergic conjunctivitis, such as itching, sneezing, rhino rhea, lacrimation, conjunctively hyperemia; hay fever (pollinosis), urticaria, including chronic idiopathic urticaria, angioedema; other allergic dermatitis, accompanied by itching and rash.

Levocetirizine is contraindicated in case of hypersensitivity to any of the components of the drug, in severe form of chronic renal failure (CRF). It is also not recommended to prescribe it to women during pregnancy and lactation.

The drug is easy to use: 1 tablet (5 mg of levocetirizine) per day, regardless of the meal. Thus, levocetirizine has a high therapeutic efficacy in the treatment of widespread itching dermatitis (atopic dermatitis, chronic urticaria), contributes to the disappearance of itching, rapid resolution of lesions and prevents the appearance of new ones. Levocetirizine is distinguished by a high degree of safety, the absence of pronounced side effects and good tolerance, and can also be recommended for use in clinical practice.

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# VETERINARY SCIENCES

### **PROGRAM OF BIOSAFETY IN GROWING DUCKS**

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Implementing biosecurity program in any sector is one of the main elements of its industrial activity, particularly in poultry.

In modern industrial duckling in Ukraine is an important and urgent problem of control of poultry infections. Modern industrial poultry creates prerequisites for improving performance rapid spread of infectious agents and their mutations. Of particular importance it acquires using the genetic potential of high-performance domestic and foreign poultry breeding aimed at obtaining maximum performance. This leads to a decrease adaptation abilities of birds to environmental and technological factors that have a place in modern industrial poultry. Against this background among poultry pathogens sharply pathogens most commonly circulating in various associations, dramatically reducing the resistance of poultry versus monoinfection and adversely affect the immunological reactivity [2, p. 232]. A necessary condition for growing, maintaining a healthy population of highly ducks and produce quality and safe poultry products is an effective set of veterinary and sanitary measures. To ensure stable epizootic welfare conducted constant monitoring of microbial contamination of air space and poultry systematic preventive disinfection of rooms and objects of veterinary-sanitary measures (technological equipment, inventory and packaging poultry farms are an integral part of the process of growing healthy poultry) [1, p. 1].

The complex system of biosafety and ensure its careful control, monitoring economic results of implementing biosafety regulations, that is why we can assess any risks envisaged production protocol and in time to prevent contamination of poultry pathogens [4, p. 36].

Maintenance and introduction of biosecurity measures consisting of disinfection and disinfestation. The system of control measures requires proper planning poultry, training, knowledge and monitoring their performance and understand that any process requires constant adjustment. In a production environment is important to consider the factors that cause appearance of risks in the economy [3, p. 157].

The advantage of the introduction of biosecurity on the farm is to ensure stable and efficient production cycle [5, p. 215].

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Biosecurity program when growing conditions ducks in poultry farms include: a clear division of sanitary and working areas, sanitary schedule breaks, accounting use of antibiotics, vaccinations individual programs, integrated programs and treatments disinfection of premises and equipment inventory. Conditions of effective implementation of biosafety is an individual development program in a production environment.

One of the stages of individual programs to disinfect poultry facilities include a thorough analysis of production capacity, the epizootic situation, microbiological screening of air and objects poultry houses during breaks mizhtsyklovyh breeding ducks circulating strains sensitivity to disinfectants, the application of disinfectants rotation schemes, quality control disinfection.

Develop a plan of regular disinfection in terms of economy based on science-based and targeted applications of drugs, introduction of clear processes, identifying key tasks and solving specific problems epizootic ensure the minimization of risks and the stability and efficiency of the production cycle.

The program biosafety propose to apply generally accepted principles, operating plants in the closed mode, mandatory compliance of clean and dirty areas.

Washing facilities encourage carried out in three stages: wetting, exposure and rinsing with water under high pressure. Modern technology involves the use of washing detergent foam, sometimes with disinfection effect. Aerosol disinfection allows destroy flora in remote places. Are effective surface disinfection of poultry premises directed sprays. Directed spray with a mass median particle diameter  $85\pm15$  microns receiving with a special spray (productivity 900-1100 ml / min). Unsealed directed sprays disinfect the premises, platforms, extensions, some equipment, slot floors and heating batteries, heated to 40 ° C and above and adjacent surfaces from a distance of 1.5-2 m, providing a uniform coating of thin film disinfectant product.

Slotted floors in poultry premises disinfected recommend directed spray disinfectant (sodium hypochlorite containing active chlorine 5%, 10% solution of the drug nadotstovoyi acid). Flow rate for processing of 1 m2 of total surface Slit floors (including the side and bottom surface lattice floors) should be at least 200 cm3. Slotted floors directed spray treated twice by moving the nozzle cracks across the floor at a distance of 0.5-0.7 m. The angle of the axis of the nozzle should be 60 ° to the horizontal floor. The disinfection of incubators and hatchery recommend the spray disinfectants, given the sensitivity of the circulating strains to disinfectants and following the instructions for their use. After disinfection of poultry houses several items washed with water.

Effective in farms biosecurity program is the use of rotation of disinfectants on the basis of periodic replacement of used disinfectants.

It is carried out to prevent the emergence of resistance to the action of disinfectants and as a result, the spread of infections. One of the main reasons for the spread of infections is gaining strains of microorganisms resistance to disinfectants, ie, the emergence of resistant strains. The reason could be the same long-term use of disinfectants. Fastest formed in microorganisms resistant to surfactants necessary by prevent the development of resistance to disinfectants are: – not to use working solutions of disinfectants in understated (bacteriostatic) concentrations; – should properly prepare working solutions and do not use disinfectants with a passing shelf life, etc.; – Only use freshly prepared working solutions of disinfectants; – does not maintain long-term working solutions of disinfectants; – monitor the stability of microorganisms to disinfectants; – promptly and properly conduct rotation of disinfectants.

For rational use of disinfectants recommended: use active ingredients from different chemical classes, different mechanisms of action on microbial cells; change the group disinfectants during work intervals of 3-6 months; Current treatment and conduct general cleaning with disinfectant active ingredients of different chemical groups; do not underestimate the concentration of working solutions; optimize the choice of disinfectants on disinfection. In the case of disinfectant in terms of poultry farms should pay attention to the active ingredients to predict drug efficacy bactericidal effect on microorganisms, and with it the full biodegradable disinfectants to non-toxic components. Thus, in terms of management, Biosafety – an effective and most economical way to protect poultry farms from infectious agents. This system measures to prevent contact with ducks pathogenic factor which is complemented by regular monitoring of diseases and vaccination programs.

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# **CHICKEN MITE: EPIDEMIOLOGICAL ASPECTS OF DISTRIBUTION**

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The world's industrial poultry industry faces a number of insurmountable problems, in particular parasitization on poultry and production facilities of various types of mites (Acari) [1, p. 69; 2, p. 12; 3, p. 25]. The problem of colonization of poultry breeding facilities by chicken mites is also relevant for modern poultry farming in Ukraine, regardless of soil and climate conditions. A huge problem is the chicken tick Dermanyssus gallinae when laying hens. From the parasitization of chicken mites, poultry farms suffer from both floor and cell-battery methods of keeping the poultry. At the latter, it is much more difficult to carry out a set of deactivation measures, since the bulk of the ectoparasites is localized in hard-toreach places for processing, at the corners of technological equipment and crevices. Because of this, in some cases insecto-acaricidal drugs do not get enough to the colony of ticks. The problem of dermanisiosis is extremely acute in the springsummer period, which is associated with an increase in the temperature of the environment and activation of the development of ectoparasites, including in natural biotopes [4, p. 140; 5, p. 150; 6, p. 30]. Other productive birds are also susceptible to invasion by chicken mites [7, p. 181]. Chicken mite is one of the most common ectoparasites of laying hens in Europe. The damage from red mites for industrial egg production in the EU is 130 million euros annually at a total cost of 0.43 euros per chicken. In invasive livestock, it is noted: a decrease in the safety of livestock and egg production, a decrease in the quality of the products obtained, a deterioration in the conversion of fodder, the biological value of embryos and hatchability of eggs, an increase in susceptibility to various diseases of infectious etiology [8, p. 23; 9, p. 442; 10, p. 862]. Promotes the spread of chicken tick very low selective activity. Susceptible to invasion are more than 30 species of birds, including synanthropic ones. This contributes to the further distribution of chicken mites in the biotopes. As a result, parasitological monitoring of poultry farms and poultry farms regarding the Dermanyssus gallinae tick is of great relevance in poultry farming [11, p. 68; 12, p. 3].

Research was carried out at poultry enterprises that specialize in the cultivation of different species and breeds of productive poultry: laying hens, broilers, turkeys, ducks, geese, quails, ostriches. In determining the epizootic situation, the technology of keeping the poultry and the season of the year was taken into account. The conditions of keeping and feeding the poultry corresponded to the current requirements (DSTU 2120-2002). A study of the taxonomic composition of ticks was carried out in I.I. Schmalhausen Institute of Zoology of the National Academy of

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Sciences of Ukraine. When carrying out a parasitological survey of poultry houses, we paid attention to the accumulation of dust on cellular batteries, under various technological equipment. Petri dishes were collected from 100 square meters of dust from ten locations in each house. Under laboratory conditions, they were placed near a heat source, heating to  $35-40^{\circ}$ C, thereby activating the motor activity of ectoparasites. Selectively examined the bird, isolated from various sections of cellular batteries, paying attention to the underwing areas, head, stomach. At least 10-15 % of the poultry from each farm was subjected to inspection.

As a result of monitoring studies of poultry farms from the breeding of laying hens, when they were kept in cell batteries, 76.5 % of the premises were invaded and populated with chicken mites. In industrial poultry farming, the intensity of invasion depended on the duration of maintenance of laying hens in poultry houses. Extensity of invasion was minimal -23.5 % in 2 months after planting birds in poultry houses and reached 100% before the end of the production cycle. When introducing chicken mites from outside from the outside into a prosperous farm, a high degree of colonization of the *Dermanyssus gallinae* was recorded in 80-100 days, with chickens in poultry houses. Eggs from dysfunctional poultry houses had characteristic contamination of the shell (Figure 1).



Figure 1. Chicken eggs contaminated with red mite

Layers in the industrial sector were free from acariform ticks Knemidocoptes mutans. Invasion of laying hens with chicken mites in private farmsteads was detected in 10.2% of cases. On the poultry of private mites, *Knemidocoptes mutans* were identified in 36.7 % of cases when keeping chickens without replacement of the livestock for at least 3-5 years.

Under these conditions, poly-invasion was more often detected by mites and mallophages, in particular *Dermanyssus gallinae* + *Menopon gallinae*, *Menacanthus stramineus*; *Dermanyssus gallinae* + *Menopon gallinae*, *Menacanthus stramineus* + *Knemidocoptes mutans*, *Menopon gallinae*, *Menacanthus stramineus* + *Knemidocoptes mutans*.

The extent of invasion by chicken mites reached a maximum in July-August, while the number of mallophages during this period was minimal. Chicken mite *Dermanyssus gallinae* was isolated in 12.3 % of the surveyed broiler farms, with outdoor maintenance. The population of hen houses with chicken mites reached the average intensity of invasion on the 15th day of growing broilers, and on the 35-40<sup>th</sup> day a high degree of colonization of the *Dermanyssus gallinae* was recorded (Figure 2).



Figure 2. Imago of chicken mite Dermanyssus gallinae

About 28.5 % of turkey farms, about 42.9 % from quail breeding, 17.3 % from breeding of poultry were unsuccessful relative to chicken mites. In the ostriches identified a specific mite *Gabucinia bicaudata*.

As a result of parasitological monitoring of poultry enterprises from breeding of productive birds, it was established that the colonization of their *Dermanyssus gallinae* with chicken ticks is widespread, regardless of the type, age and technology of keeping the poultry.

Over the past 7 years, the number of poultry farms affected by chicken mites has increased several folds.

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# CHARACTERISTICS OF THE MICROSCOPIC STRUCTURE OF COAT HAIR CUTIQUE OF CAMEROON BREED (CAPRA AEGAGRUS HIRCUS)

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Microscopic and morphometric indices of animals hair of different species have specific features important for identifying a particular species of animal [1; 4; 7, p. 13; 9, p. 2].

Despite the fact that at present, the latest scientific methods for determining the species of animals at the molecular level are used, morphological methods for determining the species of animals by the characteristics of anatomical structures, namely the microstructure of the hair, remain relevant [5, p. 27; 9, p. 4; 10].

The skin of mammals is covered with hair. It covers almost the entire surface of the body, protecting the body from cooling, and the skin – from mechanical damage and sunlight. Hair consists of three layers – core, peel and cuticles. The superficial layer of hair – the cuticle – consists of one series of horny scales, which tile-like cover the cortical substance [1-3; 8; 9, p. 7].

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One of the most modern and more precise laboratory methods are scanning electron microscopy, which allows you to differentiate biological objects at the microscopic level [4; 6; 7, p. 14; 10]. Therefore, the purpose of our work was to investigate the microstructure of the surface hair samples of the Cameroonian goat breed (*Capra aegagrus hircus*) and identify the characteristic features of the microscopic structure inherent in the test animal species.

The research was carried out in the laboratory of electron microscopy of the Sumy National Agrarian University. Preparation of samples for the study included the following steps: selection of biological material; degreasing (96% alcohol); drawing samples on the table; silver dusting using VUP and placing in a chamber of raster electron microscope REM-106I (Selmi).

For this purpose, samples of hair covering 5 goats in the region of the middle third of the spine and middle third of the neck were selected. The microstructure of the hair surface was investigated using a raster electron microscope REM-106I in the range of magnifications from 500 to 1500 times.

The morphometric characteristics of the cuticle were described by REM images using the Digimiser 4.0 digital image analysis program. The following parameters [1] were investigated: the thickness and shape of the hair, the frequency of the location of the scales (as the average number of scales along the line at 100  $\mu$ m along the length of the hair), the transverse dimension of the widest part of the scales. The used program allowed to make a statistical calculation of the average minimum and maximum values of the studied parameters (Figure 1).



Figure 1. Investigation of morphometric parameters of hair cuticle *Capra aegagrus hircus* for digital REM-photos in the program Digimizer 4.0

Research results. As a result of studies found that hair goats selected in the neck and spine has significant differences pattern cuticles, shape and thickness (Figure 2).



Figure 2. Goat hair: a – spine (74,13 μm), b – neck (145,87 μm)

Hair derived from goat spine (Figure 2a) has a cylindrical shape thickness  $74,13\pm0,24$  µm. Surface cuticle pattern is distinct, has the form of a regular wave formed from solid expanded petals. The number of waves on the hair surface per 100 µm in length is 12. Scales on the surface of the hair slightly different in shape, with sharp edges, tight to the surface of hair, longitudinal direction. The size of the scales (wavelength) varies in the range 4,35-10,88 µm.

Hair of *Capra aegagrus hircus* taken from the neck area (Figure 2b), flattened shape in the thickness 145,87-149,24  $\mu$ m. Surface cuticle pattern is crisp, formed from scales of various sizes with torn edges and has the appearance of an irregular wave. The number of waves on the hair surface per 100  $\mu$ m in length is 10. Scales on the hair surface vary in shape, don't have clear edges, sometimes loosely adjacent to the surface of the hair, longitudinal direction. The size of the scales (wavelength) varies in the range 4,57-18,72  $\mu$ m.

As a result of the study, it should be noted that the hair of Capra aegagrus hircus, taken from different parts of the body, differs from all the studied parameters: shape, thickness, specific surface pattern of the cuticle, which provides the basis for more detailed research in this direction in order to identify a particular species of animals.

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# MEDICINES FOR IMMUNOLOGICAL PROPHYLAXIS AGAINST INFECTIOUS DISEASES AND POULTRY EIMERIOSIS AT THE DOMESTIC PHARMACEUTICAL MARKET

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The number of poultry head in Ukraine was amounted to 210.8 million according to the data up to 01.01.2019 and 118 million from these heads were concentrated on poultry farms [3]. As an intensive industry, poultry farming is aimed to increase production volumes continuously, at the same time to reduce the cost of poultry's maintenance and feeding. Under such conditions, the birds are affected by a significant number of stress factors that provoke the decrease of body's resistance. Similar trends increase the percentage of poultry disease. 35–70 % of losses in poultry farming were caused by invasive diseases, among which the most unprofitable is eimeriosis. Each year the losses caused by eimeriosis in the world are about 500 \$ million [8, p. 7].

Chemotherapy is still considered to be the most effective and economically proved measure to prevent and control eimerosis. The negative aspect of chemoprophylaxis of eimeriosis is its high embryotoxicity and a negative effect on hens' reproductive system [4, p. 126; 5, p. 35]. In addition, long-termed unlimited use of synthetic agents contributes to the development of resistance to all types of eimeries. The degree of resistance to certain medicines during chemotherapy is so great that new approaches for treatment must be found [1, p. 14; 2, p. 27; 9].

A prospective direction in the fight against eimeriosis is immunological prophylaxis [6, p. 13; 8, p. 35].

There are about 20 vaccines against hen eimeriosis in the world today. Vaccines with live pathogens, injection vaccines and vaccines developed on the basis of

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molecular biotechnology (recombinant, DNA vaccine, etc.) have been developed for immunological prophylaxis of poultry eimeriosis [4, p. 126; 6, p. 13; 8, p. 11].

Taking into considerations all above mentioned aspects, the definition and analysis of the spectrum of vaccine available on the pharmaceutical market for the immunological prophylaxis against infectious diseases and poultry eimeirosis is an actual issue.

The purpose of the work was to investigate the market of vaccines medicines for poultry and particular, medicines for poultry immunological prophylaxis registered in Ukraine. The study of the range of immune biological medicines was carried out by analyzing official sources of information [7]. During the study, statistical, comparative and analytical methods of analysis were used.

According to the data on 01.01.2019, 623 immunological products with valid registration certificates were registered at the veterinary pharmaceutical market of Ukraine [7]. The range of vaccines for poultry includes 241 trade names (TN) and it is accounted 38.7 % from the total. 73.9 % (178 TN) vaccines – against certain poultry diseases. Immune biological preparations against certain poultry diseases are mainly vaccines against Newcastle disease – 22.5 % (40 TN), infectious bronchitis – 14.6 % (26 TN) and infectious bursal disease – 12.4 % (22 TN). In general, in the market of immune biological medicines there are vaccines against 23 poultry diseases – 22 diseases of infectious etiology and 1 – invasive (eimeriosis).

Moreover, 26.1 % (63 TN) of vaccines were complex. Among them there are dual-valued associated vaccines -52.4 % (33 TN), namely the vaccine against Newcastle disease and infectious bronchitis -51.5 % (17 TN).

The vaccine for hens is dominated -96.7 % (233 TN) in the structure of the assortment. The vaccines presented for certain types of poultry (turkeys, ducks, geese, pigeons) make up 3.3 % (8 TN) that is a bit smaller quantities. Totally 85.9 % of vaccines for poultry are of foreign production and only 14.1 % – are produced in Ukraine.

Imported vaccine medicines for poultry are represented by 15 producer countries, the leading position among which is the USA - 47 TN, Italy - 37 TN, the Netherlands - 35 TN and Spain - 25 TN.

There are some available vaccines of foreign production against eimeria (Canada, USA, United Kingdom, Spain, Australia, Czech Republic) at the pharmaceutical market. Immunization against eimeriosis must be carried out on hens mainly in poultry breeding and commercial poultry farms, especially when birds are kept on the floor.

The volume of vaccines against poultry eimeria at the pharmaceutical market of Ukraine is 5.6 % (10 TN). Among them, the percentage of live virulent vaccines is 30 % (*Immucox-3, Immucox-5, Immucox CII*). Immunococcus vaccine (Ceva Animal Health Inc., Canada) includes oocytes with vitamins and vitamins. These vaccines contain from 3 to 5 types of virulent most common oocyst eimeria: *E. tenella*, *E. acervulina*, *E. maxima*, *E. brunetti*, *E necatrix*.

It is rational to use vaccine medicines, the species composition of which corresponds to the actual species for the given geographic area. This is due to the fact

that any vaccine can expand the species composition of the pathogen, which circulates in the poultry factory [5, p. 35].

It is believed that the use of live non-acetone vaccines is accompanied by lesions of the intestinal mucosa of the bird. On the one hand, it is good stimulates the development of active immunity and on the other, it promotes the emergence of necrotic bacterial enteritis, due to the activation of *Clostridium perfringens* [6, p. 127; 8, p. 11].

At present, the percentage of live attenuated vaccines against bird eimerosis is higher -70% and is represented by TN as *Livacox Q*, *ADVENT*®, *Fortegra*, *EVALON*, *Paracox*, *Paracox-5*, *Eimeriavax 4m*. These vaccines are three-, four- and eight-valented. The attenuated vaccines include oocytes, emerios with artificially reduced virulence. The use of attenuated vaccines is accompanied with minimal damage of intestinal mucosa of the bird and does not provoke the development of necrotic enteritis.

In accordance with the vaccine guidelines, single-dose immunizations are carried out on mainly clinically healthy chickens aged 1–5 or 14 days. Immunization is done with spray-method, gel-drip method, with the help of watering or in eyes.

Conclusions: 1. Vaccines for poultry make up 38.7 % of the total number of immune biological medicines in the domestic pharmaceutical market.

2. Vaccines against certain avian diseases make up 73.9 %, among them the vast majority – against Newcastle disease (22.5 %). The share of polyvalent associated vaccines is 26.1 %, the bivalent associated vaccines make up 52.4%, namely the Newcastle disease and infectious bronchitis vaccine (17 TN).

3. 85.9 % of vaccines for poultry – for eign production and only 14.1 % – are produced in Ukraine.

4. Vaccines against poultry eimeria at the domestic pharmaceutical market make up 5.6% and are of foreign origin.

5. The leading type of vaccine against eimeriosis is live attenuated vaccine -70 %.

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### THE STUDY OF EFFECTIVENESS **OF COCCIDIOSIS PROPHYLAXIS IN YOUNG RABBITS**

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Coccidiosis (eimeriosis) is an animal disease that is widespread in the world and causes significant economic damage to the agriculture. Due to the technological features of keeping rabbits in cages, they are massively susceptible to this disease. Studies show, that the infection of rabbits with coccidiosis in different areas varies from 30 to 100 %. The death of infested young rabbits reaches 80-100 %. Sick animals lag behind in growth and lose from 12 to 30 % of their weight. Adult animals are less sensitive to coccidiosis, but they are carriers and sources of the eimeric infection [2, p. 46-47; 4]. Thus, the protection from coccidiosis is an important area of veterinary medicine. In connection with the rapid adaptation of the simplest Eimeria to the drugs used, it is necessary to constantly search for new treatment regimens and to replace them reasonably [5, p. 159-162; 6].

The aim of this research is to determine the time of occurrence of resistance of the coccidiosis causative agents to the acidifier "Kronocide-L" as well as to develop recommendations on prevention the reduction of treatment effectiveness.

Scientific novelty of the work - the relationship between the drugs used for the treatment of rearing females and underperformance of these drugs in the treatment of young animals was determined, as well as schemes and recommendations to prevent this phenomenon were developed.

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The research was carried out during 2018 on the basis of private sector in Zaporizhia Oblast. Five infested rearing females, which were treated for coccidiosis were selected for these studies. The youngsters of these females were kept separately from the other rabbits and were divided into two or three groups of ten animal units: two groups depending on the treatment regimen and one control group. The studies were conducted sequentially with two litters of youngsters with three months interval.

Acidifier "Kronocide-L" was chosen for the research as an environmentally safe cure for the prevention and treatment of coccidiosis in rabbits. Acidifier also improves digestion and inhibits the development of opportunistic pathogenic microflora. It is an additional source of phosphorus and microelements, and it increases animal productivit. After clinical manifestations of coccidiosis were noted – weight loss, indigestion and depression, and when the infection was laboratory-confirmed, the treatment of youngsters began Clinical observations were carried out from 1 to 21 day of treatment. The level of eimeric infection was determined by means of scatoscopy method, by counting the number of oocysts in the preparation according to [1, p. 428-429] before treatment and on 7, 14 and 21 day.

Treatment of young rabbits of the first group was carried out by "Kronocide-L" acidifier at a concentration of 0,10 l per ton of water, the second group – "Kronocide-L" acidifier at a concentration of 0,15 l per ton of water. The control group did not receive any treatment for coccidiosis until the end of the studies. Before the second and third connubium, females received a prophylactic course of acidifier "Kronocide-L" at a concentration of 0,15 l per ton of water. Youngsters didn't receive preventive treatment, the infection with eimeriosis was caused by the fecal-oral route, resulting from the high concentration of animals in cages and impossibility to ensure the absolute sterility of cages on the farm after infected animals were kept there.

Studies of feces of infested rabbits found E. stiedae, E. perforans, E. Magna, E. media oocysts.

The results of studies (prevalence P, extensive efficiency of the preparation EE and lethality for the period of treatment) are summarized in Table 1.

The results show that the extent efficiency of the acidifier in the first group of rabbits (that were given the same preparation as the rearing females) decreased from litter to litter. Extent efficiency of the preparation in the second group (with a concentration of 0,15 l per ton of water) remained practically at the same level. Prevalence in rabbits of the control group has not changed, the mortality amounted to 50-80% during the observation. With the appearance of clinical signs, a rapid decrease of albumin and total protein in blood serum has been noted in rabbits affected with eimeriosis.

The change in globulin index is proved by the level of thymol test which shows the amount of lipoproteins and beta- and gamma- globulins in the blood serum of infected animals. On the sixteenth day, the total bilirubin level increased four times in comparison with this indicator in healthy rabbits.

The results of the biochemical analysis of the blood of experimental rabbits are given in Table 2.

Table 1

| The first litter |                         |              |     |          |    |                      |    |    |                |
|------------------|-------------------------|--------------|-----|----------|----|----------------------|----|----|----------------|
| Group            | Number of rabbits       | P, % Eimeria |     |          |    | EE, %<br>preparation |    | on | Lethal         |
|                  |                         | 0            | 7   | ay<br>14 | 21 | 7                    | 14 | 21 | outcome        |
| 1                | 10                      | 100          | 89  | 16       | 3  | 11                   | 84 | 97 | 0              |
| 2                | 10                      | 100          | 91  | 15       | 2  | 9                    | 85 | 98 | 1              |
| Control<br>group | 10                      | 100          | 95  | 102      | 97 | -                    | -  | -  | 7              |
| Second litter    |                         |              |     |          |    |                      |    |    |                |
|                  | Group Number of rabbits | P, % Eimeria |     |          |    | EE, %<br>preparation |    |    | Lethal outcome |
| Group            |                         | Day          |     |          |    | Day                  |    |    |                |
|                  |                         | 0            | 7   | 14       | 21 | 7                    | 14 | 21 |                |
| 1                | 10                      | 100          | 84  | 21       | 9  | 16                   | 79 | 91 | 1              |
| 2                | 10                      | 100          | 89  | 15       | 4  | 11                   | 85 | 96 | 0              |
| Control<br>group | 10                      | 100          | 103 | 98       | 97 | -                    | -  | -  | 5              |

### Dynamics of eimeric infection in rabbits

### Table 2

# Changes in indicators of total protein, albumin, thymol test and bilirubin in blood serum of rabbits affected with eimeriosis

|  | Control            | Research                              |                     |                     |                          |  |  |  |  |
|--|--------------------|---------------------------------------|---------------------|---------------------|--------------------------|--|--|--|--|
| Indicators   | (n-10)             | Day 3 day                             | Day 6               | Day 10              | Day 16                   |  |  |  |  |
|  | (II=10)            | (n=30)                                | (n=30)              | (n=30)              | (n=30)                   |  |  |  |  |
| Total protein,<br>g / l                                      | 57,3 ± 1,15        | $66,9\pm 0,92^{3)} 71,4\pm 0,99^{3)}$ |                     | $70,0 \pm 1,05$     | 41,6 ±0,81 <sup>3)</sup> |  |  |  |  |
| Albumin,<br>g / l  | $39,1 \pm 0,72$    | 33,6±1,01 <sup>2)</sup>               | $29,9\pm 1,52^{3)}$ | $24,5\pm 0,75^{3)}$ | $21,7\pm 0,67^{3)}$      |  |  |  |  |
| Thymol test, pcs.  | $2,3 \pm 0,12$     | $3,3 \pm 0,28^{2)}$                   | $3,9 \pm 0,31^{3)}$ | $3,7\pm 0,27^{2)}$  | $2,\!4 \pm 0,\!27$       |  |  |  |  |
| Total bilirubin,<br>μmol / l                                 | $7,\!4 \pm 0,\!24$ | $10,5\pm 1,19^{1)}$                   | $13,3\pm 1,32^{2}$  | $18,9\pm 0,87^{3)}$ | $31,2\pm 0,63^{3)}$      |  |  |  |  |
| Direct bilirubin,<br>µmol / 1                                | $2,4 \pm 0,15$     | $4,2 \pm 0,83$                        | $4,0 \pm 0,56^{1)}$ | $7,2 \pm 0,38^{3)}$ | 14,7 $\pm 0,16^{3)}$     |  |  |  |  |
| Indirect bilirubin<br>µmol / 1                               | $5,1 \pm 0,35$     | $6,4\pm 0,42^{1)}$                    | $9,1\pm0,81^{2)}$   | $11,5\pm 0,51^{3)}$ | $17,1\pm0,66^{3)}$       |  |  |  |  |
| Note: $^{1)}$ p <0,05; $^{2)}$ - p <0,01; $^{3)}$ - p <0,001 |                    |                                       |                     |                     |                          |  |  |  |  |

As a result of hepatic ducts obstruction, obstructive jaundice occurs, the development of which is affected by an increase of the bilirubin level in the rabbits' blood. On the sixteenth day, the indicator of urea in the blood serum of infected rabbits continued to increase and was 6,5 times higher, comparing to the healthy rabbits. That provides evidence of hepatorenal syndrome and impaired renal

filtration [3]. Resistance of the simplest Eimeria to the acidifier "Kronocid-L" in a concentration of 0,10-0,15 l per ton of water occurred in young rabbits under investigation after the preparation was repeatedly used for prophylaxis.

Thus the use of acidifier "Kronocid-L" in a concentration of 0,5 liters per ton of water could be recommended for regular use on the farm, including preventive courses.

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# AGRICULTURAL SCIENCES

# THE INFLUENCE OF SOWING DENSITY AND ROW SPACING **ON PLANTS HEIGHT, DIAMETER OF THE ACHENES** AND QUANTITY SEEDS IN ACHENES OF SUNFLOWER HYBRIDES UNDER THE CONDITIONS OF THE RIGHT-BANK FOREST AND STEPPE REGION OF UKRAINE

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One of the effective factors regulating the use of moisture, light, the intensity of the assimilation process and the formation of the crops is the amount of plants per area unit. The relationship between productivity and plant density is manifested differently depending on the soil and climate conditions, the biological characteristics of hybrids and agricultural engineering [1, p. 8; 2, p. 41].

The results of our research indicate that the height of the plants and the diameter of the achenes depending on the sowing density and row spacing. In the testing sample with a density of 70 thousand / ha, the height of plants in the hybrid Zagrava with a row spacing of 70 cm was on average 186.4 cm, and with a row spacing of 45 cm -185.6 cm. Ukrainian F1 hybrid within a row spacing of 70 cm shows 193.8 cm, and within a row spacing of 45 cm the result is 190.7 cm, while in the years of research there was no significant difference in the height of plants at a density of 70 and 90 thousand / ha.

The lower height of plants was observed at a density of 50 thousand / ha - in the early ripening hybrid Zagrava with an intermediate row spacing of 45 cm - 182 cm, and with an intermediate row of 70 cm - 183.5 cm, in the middle hybrid Ukrainian F1 with an intermediate row spacing of 45 cm - 185.9 cm and with an intermediate row spacing of 70 cm - 188.1 cm.

Within planting density of 90 thousand plants per 1 hectare the plants were the highest – in hybrid Zagrava with a row spacing of 45 cm – 190.4 cm, a row spacing of 70 cm – 192.5 cm, F1 hybrid Ukrainian within a row spacing of 45 cm – 196,1 cm, with a row spacing of 70 cm - 198.3 cm, 4.8 cm more than in hybrid Zagrava with a row spacing of 45 cm and 6.1 cm with a row spacing of 70 cm and a Ukrainian F1 hybrid with a row spacing of 45 cm by 5.4 cm and with a row spacing of 70 cm by 4,5 cm in comparison with the density of 70 thousand plants per hectare.

The diameter of the achenes has varied, depending on the seeding density and the width of the row spacing, in both hybrids within the range of 17.5-22.3 cm. The

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Zagrava hybrid sunflower formed larger achenes of 22.3 cm in 2016 at a density of 70 thousand plants per hectare and a width of a row spacing of 70 cm, and smaller - 17.5 cm with a width of 45 cm between rows and a density of 50 thousand plants / ha in 2017. In versions with a density of 90 thousand / ha the plants formed achenes size - respectively 18.5 and 19.9 cm, the difference was 1.4 cm and was not significant.

Under the conditions of unequal provision of life factors and depending on the density of plant standing per unit area between the height of the stem and the number of seeds can be traced backward dependence: with thickening the height of plants increases, and the number of flowers and subsequent seeds in the achenes decreases [3, p. 70; 4, p. 84].

At a low illumination during the period of differentiation of the growth cone (thickening of crops, significant weediness, cloudy weather, etc.), less flowers are laid down in the achenes and empty seeds occurs, and accordingly the amount of seeds decreases [5, p. 122].

In our research it was noted that with an increase in the density from 50 to 70 thousand plants / ha, the amount of seeds in the achenes increased significantly, reaching the maximum value in the variant of 70 thousand plants per hectare in the hybrid Zagrava with a width of row spacing of 70 cm - 1670 units, per years of research. With crops thickened to 90 thousand plants / ha, on the contrary, the amount of seeds decreased.

The minimum value of this indicator took place at a density of 90 thousand plants per hectare in the hybrid Ukrainian F1 with a width of rows of 45 cm - 1315 units.

It should also be noted the effect of weather conditions on the change in the amount of seed in the achenes. In more favorable year of 2016 in hybrid Zagrava this figure, depending on stand density was higher by 2,6-9,9 %, and Ukrainian F1 hybrid at 1-5,3% than in the years of 2017 and 2018. The reason was in a lack of moisture in the soil during the pouring and maturation of the seeds.

The total amount of seeds and the number of defective seeds are the markers on which empty grains depend; with an increase in the number of defective and a decrease of the normal seeds, empty grains are increasing [6, p. 86].

Blank seeds depended on the density of plants, and on climate conditions. Thus, in 2017 due to a number of bad conditions, seeds of hybrid Zagrava were on 0,5-2,9 % higher than in 2016 and 2018, and the Ukrainian F1 hybrid to 0,3-2,2% in accordance.

Within a density of 50 thousand plants / ha, the empty seeds in the hybrid Zagrava at the width of a rowing space of 45 cm were 15,6 %, and in the Ukrainian F1 hybrid – 15,2 %. With the thickening of crops to 90 thousand plants per hectare, the number of defective seeds increased and the index of empty seeds in the Zagrava hybrid was 24,5 %, while in the Ukrainian F1 hybrid – 22,9 %.

Thus, in order to grow both hybrids, early ripening Zagrava and middle ripening Ukrainian F1, under the conditions of the Right-Bank Forest Steppe of Ukraine, the optimum placement of plants in agrocenosis is the density of 70 thousand plants per hectare and the width of a row spacing of 70 cm, at which the highest seed quantity and larger diameter of the sunflower of achenes were obtained.
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## MANIFESTATION OF THE GENETIC POTENTIAL OF NEW VARIETIES OF BUCKWHEAT IN THE CONDITIONS OF THE NORTH-EASTERN FOREST-STEPPE OF UKRAINE

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Obtaining steady and high yields of agricultural crops is inextricably linked to the soil fertility, which depends on the intensity of organisms' processes in the soil.

Improving the agrotechnical methods of buckwheat cultivation through the technology elements combination (choice of cultivars, biological preparations, mineral fertilizers, plant growth regulators, microfertilizers) will contribute to the implementation of its genetic potential [1, p. 320].

In the technology of growing crops, plant growth regulators are an important factor in controlling the growth and development of plants. Growth regulators give the opportunity to better realize the potential of plants, regulate the ripening periods, improve the quality of products and increase yields. The basis of microbiological preparations are live microorganisms, which are characterized by a complex of agronomic-beneficial properties – nitrogen fixation, phosphate mobilization, growth stimulation and antagonism to phytopathogens [2, p. 26-30].

Important role in the formation of crops is devoted to fertilizers, but there are questions remain of their interaction with microbial preparations and its impact on the

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productivity of buckwheat. By changing the chemical composition of the substances entering the plants, its number and time of receipt, it is possible to increase the yield, toenhance the growth, to improve the chemical composition and quality of the products, as well as to increase the plants resistance to adverse conditions.

The application effectiveness depends on the degree of its compliance with the biological requirements of agricultural crops in specific soil and climatic conditions [3, p. 140-142].

Literary data testify to the positive influence of microbiological agents and plant growth regulators on the production of grain crop yields [4, p. 96-100]. Improvement of plant productivity can be achieved not only by breeding methods, but also by introducing the necessary fertilizer rates and incorporating biological preparations into a set of successive technological cultivation operations [5, p. 89-94].

Experiments with buckwheat were conducted in the short-term field crop rotation of the Institute of Agriculture of the North East NAAS, which is located in the conditions of the northeastern Forest-Steppe of Ukraine. Research methods are field trials that included phenological, biometric observations and structural analysis of plants. Soils of experimental plots– typical black soil, weakly evolved, large-pealmedium-loamed, the arable layer of which is characterized by the main indicators: content of humus – 4,1%, pH – 6,3, amount of absorbed alkaline– 31 mg equivalents, content of easy hydrolyzed nitrogen (by Cornfield) – 11.2 mg/100 g.

Weather conditions during research growing season of 2016-2018 were different and had a significant impact on buckwheat yield formation. That made it possible to investigate reaction of cultivars to the agronomic techniques that were studied in the experimental variants.

Studies with buckwheat were conducted in a three-factor experiment during 2016-2018, where: factor A –cultivars of different morpho-type; factor B –rate of mineral fertilizers ( $N_{16}P_{16}K_{16}$ ,  $N_{30}P_{45}K_{45}$ ,  $N_{15}$ ); Factor C – biological preparation (Microhumin– 200 g/ha), microfertilizer (Reakom "Grain"–0.5 l/ha), plant growth regulator (sodium humate – 1.0 l/ha).

The results of mineral fertilizers, biopreparation, growth regulator and micronutrient influence on the formation of buckwheat plants productivity in 2016-2018 years have revealed that the structure of the buckwheat crop was significantly influenced by the use of biomaterial. The intensity of plants growth and development was uneven and depended on hereditary properties and conditions of the environment.

The structural plants analysis was carried out in order to detect and characterize the influence of investigated factors on the elements of productivity in different buckwheat morphotypes cultivars. The inoculation of buckwheat seeds with the biopreparation increased the number and weight of buckwheat grains compared with the variant without biologic agent application.

According to the results, the average number of grains per plant and the weight of 1000 grains were higher in variants of Selyanochka cultivarcomparable with Slobozhanka.

Maximum number of grains per plant (48 pcs.) was recorded in variant of Selyanochka cultivar with plant growth regulator (Sodium humate 1.0 l/ha in the budding phase) in combination with mineral fertilizer  $N_{16}P_{16}K_{16}$  application into rows. Moreover, minimum number of grains per plant (40 pcs.) was formed by Selyanochka cultivarin variants without mineral fertilizers, seeds treated with water and seeds treated with Microhumin 200 g/ha, which indicates a negative effect of additional mineral nutrition absence.

Slobozhanka cultivar formed average 45 seeds perplant. Among the studied variants, the largest number of grains per plant (48 pcs.) was in the variants with plant growth regulator (Sodium humate 1.0 l/ha in the budding phase) on the background of  $N_{30}P_{45}K_{45}$  and  $N_{16}P_{16}K_{16} + N_{15}$ .

Selyanochka cultivar maximum weight of 1000 grains (26.3-27.5 g) was obtained in the variant with complex seeds inoculation by biopreparation, microfertilizer and plant treatment. These variants obtained maximum weight of grains from plant (1.27 g).

The dependence between the weight of 1000 grains and weight of grains per plant was not noted in Slobozhanka cultivar. The highest level of the weight of 1000 grains was formed in the with plant growth regulator on the background of  $N_{30}P_{45}K_{45} + N_{15} - 25.9$  g, while the weight of grains per plant was 1.12 g, which is average for experiment. Complex seed inoculation with biopreparation, microfertilizer and plants treatment by plant growth regulator provided the weight of grains per plant in the range of 1.18-1.21g, but the weight of 1000 grains was 25.1-25.6g.

The results show that the Selyanochka cultivarhad better reaction to the use of seed inoculation and the fertilizer application comparable with Slobozhanka. The increase from this measure varied in the range of +0.05-0.27 t/ha, with average +0.14 t/ha. Mineral nutrition provided the average yield increase (+0.22 t/ha) which was 0.01 t/ha lower to compare with Slobozhanka cultivar and varied in range of 0.06-0.45 t/ha. The variant with complex use of seeds treatment with biopreparation, microfertilizer and application plant growth regulator in the phase of budding, on the background of mineral fertilizers (N<sub>16</sub>P<sub>16</sub>K<sub>16</sub> + N<sub>15</sub>) formed maximum yield (2.20 t/ha) and increase from fertilizers was+0.42 t/ha, from biopreparation, microfertilizer and plant growth regulator – 0.27 t/ha.

A slightly lower yield (2.18 t/ha) was obtained in the variant with introduction of plant growth regulator into the phase of budding, with increase +0.25 t/ha, but from mineral fertilizers – +0.43 t/ha. Among the variants with inoculation of Selyanochka seeds, the highest yield was obtained after application of microfertilizer – 2.07 t/ha (increase to control (seed treated with water) was – 0.14 t/ha).

For seeds inoculation by Microhumin, the highest level of yield increase (+0.31 t/ha) was recorded with mineral fertilizers  $N_{16}P_{16}K_{16} + N_{15}$ , which was 0.13 t/ha higher compared to control variant without seed treatment.

The highest yield level (1.92 t/ha) was obtained in the variant with mineral fertilizers application into rows  $N_{30}P_{45}K_{45} + N_{15}$  with increase -+0.41 t/ha to control. Plant growth regulator Sodium humate provided +0.19 t/ha. The yield level (1.89 t/ha) after application $N_{30}P_{45}K_{45} + N_{15}$  with inoculation of buckwheat seed with

microfertilizer was 0.38 t/ha higher than in variant without mineral fertilizers and 0.16 t/ha higher compared to the variant without seed treatment but with the same rate of mineral fertilizers.

The variant with complex application of biopreparation, microfertilizer and plant growth regulator Sodium humateformed 1.83 t/ha, increase to control (without fertilizers and seeds treatment with water) was+0.32 t/ha.

Seeds inoculation of Slobozhanka cultivar by Microhumin obtained the highest yield with application of mineral fertilizers  $N_{16}P_{16}K_{16} + N_{15}$  (1.82 t/ha), which was 0.04 t/ha higher comparable to variant without seed inoculation and with the same ate of mineral fertilizers.

Comparing cultivars of different morphotypes to each other, the average yield for 2016-2018 of Selyanochka cultivar was 1.96 t/ha and ranged from 1.75 to 2.20 t/ha. But Slobozhanka cultivaraverage yield was lower -0.23 t/ha (1.73 t/ha) and ranged from 1.51 to 1.92 t/ha.

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## **INTERSPECIFIC HYBRID PRODUCTIVITY AND ITS COMPONENTS**

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Brother-sister crossing narrows down the genetic basis of starting breeding material, cultivars and, vice versa, its increase with the involvement of conspecific cultivars in breeding practice enables not only to introgress genes unavailable in cultivars, but also to have a positive impact on the productivity of potato offspring.

The nature of the inheritance of quantitative potato characters, which include productivity, can be explained by superdominance. The maximum hybridous vigour by character takes place when all four alleles in burdock are different. This state of alleles is called heteroallelism or tetraallelism. The hybridous vigour in potato is mainly based on the non-additive interaction of genes, which is manifested through the internal locus (superdominance) and interlocus (epistasis) interaction of genes and alleles. The experimental confirmation of the above is found in the works of many scientists [1, p. 7-8].

Proceeding from the fact that most varieties of the early twentieth century came from a small number of initial forms, that is, were close in genetic terms, it is needless to expect the manifestation of hybridous vigour from their breeding use. The use of interspecific hybridization is driving in this respect. Therefore, the involvement of cultivars in breeding practice makes it possible to obtain heterotic progeny in terms of productivity. The above mentioned has found numerous confirmation regarding the species of S. andigenum.

The effect of heterosis also occurs when crossing two wild species. In the five combinations with the participation of the parent form of samples of S. stoloniferum species and pollinators of S. chacoense (three populations), and S.simplicifolium and S.gourlayi species, the four ones are characterized by significant heterosis by productivity, and, for example, in the combination of S. stoloniferum (UK 82-34) x S. chacoense (UK 21-8) with the maximum productivity of the best of parents (pollinator) of 25.0 g/plant, the average value of indicators among potato offspring is 69.8 g/plant [2, p. 25-28].

The phylogenetic remoteness of wild potato species from cultivated ones, as well as the natural evolution of the former, in contrast to the selection of the best forms among the latter by autochthons, makes it impossible to obtain high-yielding forms only in the case of using wild species in crossing. And, even when obtaining interspecies hybrids involving varieties and wild species, it is impossible to obtain offspring with a higher manifestation of yield than in standard varieties. To improve the manifestation of agronomic characters among progeny from interspecific crosses it is proposed to use backcrossing, discontinuous backcrossing, or self-pollination [3, p. 188].

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An important role in the manifestation of agronomic characters among potato offspring from interspecific crossing, including productivity, is played by the selection of varieties – a component of hybridization. In the process of backcrossing it is recommended that not only one, but different varieties should be involved in hybridization. When selecting the components of crossing, it is essential to pay attention to their photoperiodism, which determines the productivity of plants. Selecting varieties for breeding, one should give consideration to the fact that the genes of control over negative features can be available in their genotype [4, p. 3-5].

It has been found that for backcrosses of complex interspecific hybrids involving phylogenetically distant species, the dominant component of productivity is the plurality of potato tubers. It has referred both to the secondary interspecific hybrids and backcrossed material. The capability of producing large tubers is manifested to a lesser extent in such material [3, p. 190]. At the same time, among the significant part of the studied forms we have managed to combine the two components of productivity and to distinguish the selection valuable forms.

The use of promising backcrosses of interspecific hybrids in the creation of varieties has resulted in obtaining hybrids that have successfully passed the competitive-environmental (the varieties of Basis, Shchedryk) and state (Dneprianka, Podolianka, Zaviia) variety testing.

According to many researchers, the success in the creation of potato varieties is largely determined by the effective and proper selection of parental forms. This is especially true for the use of interspecific hybrids by crossing components, since not only positive, but also negative characters can be inherited with their participation in terms of practical application. It is offered to select parental couples by the ecological and geographical principle. The above mentioned is also the basis for obtaining heterotic forms according to certain characters [5, p. 12-14].

It is believed that parent forms may be selected based on the results of the evaluation of potato offspring from self-pollination. Extending this area of research, it is proposed to create self-pollinated lines of potato (inbreeding line) and then use them in heterosis breeding. At the same time, it should be noted that the application of this approach is limited to inbreeding depression, which accompanies the formation of potato offspring from self-pollination. For example, it is found that the average yield of hybrids is 8.5% higher than the original forms and 35.8% lower than that of potato offspring from self-pollination.

Another method of selecting parental forms is the use of test crossing. However, the conduct of such crossings does not provide for consistency in the work that significantly complicates the determination of potential capabilities of the crossing components. At the same time, we believe that the experience of breeders is largely formed on the basis of the use of test crossing.

According to the data of individual researchers, the genetic potential of parental forms, the interaction of hereditary factors in the formation of the zygote as a result of determining the combining ability of crossing components can be characterized to the fullest extent.

In practice, this is done using the following approaches: diallel crossing, top cross or poly cross and free and uncontrolled self-pollination. It is believed that more complete information on the inheritance of characters of crossing components can be obtained by using diallel crossing.

The foregoing shows that it is too difficult to obtain potato offspring under complete diallel scheme. In this regard, top crosses are widely used to determine the genetic potential of parental forms. Their simplest form is a single test top-cross, when a female parent is pollinated by one highly fertile pollinator. In addition to the ability to set fruit effectively, the requirements for such tester include its broad genetic basis and high adaptability to growing conditions. Due to the minimum number of combinations determined by the number of maternal forms, this method of estimating heredity is the least expensive. At the same time, its information content is minimal. When using it, it is impossible to isolate the effects of general combining ability (GCA) and specific combining ability (SCA). The disadvantage of a single test top-cross is the influence of the specific interaction between hereditary factors of the pollinator and various parent forms on the manifestation of characters.

Based on the above, the two-, three-test schemes are more frequently used. This eliminates the disadvantage of diallel crossing, that is, the inability to obtain offspring under the complete scheme and, at the same time, enables to determine GCA and SCA. The relatively lower costs of conducting research, obtaining adequate information have resulted in the widespread usage of two-, three-test top-crosses.

Multi-test top-cross has much more opportunities. Its essence is in the use of two sets: the samples in one set are used as maternal forms, and in the other - as pollinators. An additional advantage of multi-test top-cross is the possibility of determining the coefficient of inheritance.

The program providing for selection of the best maternal forms and pollinators according to the general combining ability has been implemented to determine the combining ability of parental forms. Its essence is as follows: on the first stage maternal forms are pollinated with a pollen mixture. After evaluating the populations the best samples by GCA are selected, and on the second stage they are used as testers in case of multi-test top-cross.

Thus, the difficulty in involving interspecific hybrids, their backcrosses in the breeding practice is based on the significant difference between them, depending on the schemes of their obtaining, the number of species involved in crossing, backcrossing scale, effective control over agronomic characters, the optimal selection of varieties of parent components, etc. The study of these issues will enable to significantly improve the efficiency of the use of interspecific hybrids in the breeding practice and obtain new varieties with the high manifestation of characters, which are non-typical for S.tuberosum or have little expression in cultivated varieties.

Selecting the best forms based on the analysis of their origin, in order to obtain data more accurate than on the determination of the phenotypic control of characters, it is essential to determine the combining ability of hybrids by assessing the offspring from top-crosses.

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## AGRO-ECOLOGICAL BASES OF PEPPERMINT CULTIVATION USING MICROBIOLOGICAL PREPARATIONS

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Nowadays, great attention is paid to such agro-ecological problem as obtaining plant products with high qualitative parameters while soil fertility saving, which is especially important for the zones of Ukraine, where the anthropogenic load is close to the critical one [1, p. 11]. Preparations with effective microorganisms or microbiological preparations that may contain about 80 strains of beneficial microbes were developed to ensure mentioned processes. Yielding capacity of agricultural crops is increased, soil is cleared of chemical and biological contaminants, mechanical structure of the soil is improved, content of nutrients, first of all – humus is on the rise with the use of microbiological preparations [2, p. 2]. In addition, the technology positively affects the quality of products. And the most importantly is that the content of biologically active substances necessary for a human increases sharply [3, p. 8].

Currently, there are no scientifically-based technologies of peppermint growing with the use of microbiological preparations in any soil-and-climatic zones of Ukraine. Therefore, learning of these technological means for obtaining environmentally friendly products and recommendations for the implementation of the research results in production is very relevant.

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The purpose of our work was to study agro-ecological methods to grow peppermint commercial products with the use of microbiological preparations. According to the purpose, the number of tasks was set by these researches: to study peppermint plants grown with using of microbiological preparations by biometric parameters, to compare them and to evaluate the ability of these preparations to stimulate plants growth and development; to establish yielding capacity of peppermint commercial products under the use of microbiological preparations and to choose the best of them.

The research was carried out using the following microbiological preparations: EM-A – a liquid-type preparation which is ready for making of working solutions and using in production conditions; "Siaivo-2" – a new preparation of the EM "BakSib" series, concentrated form of the preparation for water dilution and introduction in the form of a solution for open and closed soil both root and out-root nutrition; EM-plate – was made of plastic with adding of "EM-ceramics" under "EM-balance" technology.

Peppermint was propagated by a vegetative method (rhizome division). Fresh unvegetated rhizomes were planted manually by checkrow pocket way (45 x 45 cm) in the second decade of April. Plants were sprayed 10 days after rhizomes planting (the first year of vegetation), or after vegetation restoring next years, and then every 7 days during vegetation. EM-plates were placed in an upright position, slightly dipped into the soil at a distance of 20 cm from the plant.

Analysis of the received results shows that the plants of different ages differ significantly in their habit, and in the first place in height, depending on the application of microbiological preparations. Periodic treatment of the plants with solutions of such preparations as "EM-A" and "Siaivo-2" had a positive effect on the plant height in the phase of full flowering, that is, before harvesting the green mass. We got an excess of 10.7-14.0 cm (on average over the years of research) while comparing the indexes of these variants with the control.

According to the results of three-year studies, the largest number of shoots on the plants had those which were fed with solutions of "EM-A" preparation in the phase of vegetation beginning. This method of microbiological preparations application provided enlarging the shoots on the plant at 0.4-6.6 pcs in the phase of flowering beginning and at 1,6-9,2 pcs in the phase of full flowering. The smallest number of shoots on the bush – 70.3 pcs was observed in the phase of full flowering on average over the years of the research in the plants of the control variant at all stages of organogenesis.

The plants which were fed with the solution of "EM-A" preparation during the entire vegetation period, which is due to more intensive branching and formation of more leaves were also distinguished by the highest area of the photosynthetic surface. In addition, the use of microbiological preparations influenced positively the development of underground, perennial part of the plant and, accordingly, it provided better conditions for plant nutrition for the next vegetation period.

In the absence of moisture in the soil and reduced air humidity, even a slight increase in leaf surface caused great loss of moisture and decrease in wateriness of plant tissues, which negatively affected the intensity of metabolism and in the final result could not affect negatively the productivity of plants. This is evidenced by the lower yield of 2.8 t/ha of whole plants faded to 55% in humidity in the control variants.

Implementing of the solution of EM-A preparation stimulated the growth of leaf mass and improved leaf coverage of peppermint plants during the vegetation period. Accordingly, yielding capacity of the plants in this experiment variant was the largest -3.9 tons/ha which is more than the index in the control variant of 1.1 tons/ha (39.3%).

Consequently, the use of microbiological preparation EM-A by its implementing during the vegetation period can be included as an effective, environmentally friendly element in the modern technology of growing this culture.

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## THE YIELD OF CHERRY TOMATO, DEPENDING ON THE INFLUENCE OF PLANT GROWTH REGULATORS IN THE RIGHT-BANK FOREST-STEPPE OF UKRAINE

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The importance of plant growth regulators for covered area is important, since accelerating the ripening of fruits grown in greenhouses can increase the yield of early, more profitable products and increase the profitability of production [1, p. 142].

The influence of plant growth regulators on the increase of crop productivity is due to the fact that they accelerate the division of cells, intensify the processes of plant life, increase the permeability of intercellular membranes and accelerate biochemical processes in them, which leads to increased processes of nutrition, respiration, photosynthesis. Thanks to these preparations the resistance of crops to unfavorable weather conditions and to their damage by pests and diseases are increased.

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In general, under the influence of biostimulants, the genetic potential of plants, created by nature and selection work, is more fully realized [2, p. 94]. However, longstanding complex studies of growth regulators of the new generation, the study of their effect on plants of new genotypes of tomato at different stages of life, their productivity and quality of fruits in conditions of covered soil were not carried out. In this connection, there is a need for a more detailed study of the influence of growth regulators on tomato plants in the conditions of greenhouses. Therefore, the use of growth regulators, determining the direction of their action on specific hybrids to increase the productivity of tomato plants when growing in greenhouses is a modern and topical task in vegetable growing.

The purpose of the experiment: to find out the influence of different plant growth regulators on the growth of the seedlings and its quality indicators, the level of acclimatization after deplantation and the productivity of the cherry tomato.

Studies on the influence of plant growth regulators on the quality of cherry tomato seedlings were conducted in 2017-2018 on the basis of the Uman National University of Horticulture in the hangar hothouse. Two hybrids of cherry tomatoes, Sun F1 and Lucy Plus F1, and three plant growth regulators: Reastim, Stimpo, and Ivin were studied. The Summer Sun-F1 hybrid was used for control with seed and seedling treatment by distilled water.

The field, static and laboratory methods of research were used during the experimental work. Phenological observations, biometric measurements, records and analyzes were conducted. Phenological observation: the beginning and mass appearance of seedlings, budding and flowering.

Before sowing, the seeds were soaked in solutions of growth regulator Reastim (10 ml / 500 ml of water for 18 hours), Stimpo (5 ml / 500 ml of water for 18 hours), Ivin (1 ml / 500 ml of water for 18 hours) and distilled water. Ivin is a synthetic preparation of auxin-like action; Stimpo (emistim C + microelements) is created by a combination of derivatives of pyridine with a complex of phytohormones analogues; Reastim is a growth regulator, which includes the fertilizer "Reakom", as well as gibberellin, amber acid, humic acids.

With the use of growth regulators, the first emerging crops were marked in the hybrid Lucy Plus F1 in variants with Ivin and Stimpo and in the hybrid Summer Sun F1 in the variant with Stimpo – on 4-5 day. In all other variants, including control, the appearance of massive crops was noted on 9-10 day.

On average, in the 2017-2018, the plants of Summer Sun F1 hybrid with using of Stimpo were blooming fastest, on 48 day. Plants in the control version bloomed 6 days later. The difference in the flowering phase between the investigated hybrids varied within ten days, and between growth regulators of a single hybrid – within 5-6 days.

Investigated growth regulators also had a significant effect on the biometric indices of the cherry tomato seedlings (Table 1).

Thus, hybrid Lucy Plus F1 predominated the studied hybrid Summer Sun F1 by the main morphological parameters, which can be explained by genetic properties. Comparing with control, the thickness of the stem increased by 0.08 cm, the leaf area increased by 1.2 dm2 per plant.

## Table 1

| Growth regulator | Thickness of stem, | Number of leaves, | Leaves area, |  |  |  |  |
|------------------|--------------------|-------------------|--------------|--|--|--|--|
| Olowul legulator | cm                 | pieces            | dm2 / plant  |  |  |  |  |
| Summer Sun F1    |                    |                   |              |  |  |  |  |
| Water (control)  | 0,64               | 7,9               | 11,2         |  |  |  |  |
| Stimpo           | 0,74               | 8,6               | 12,0         |  |  |  |  |
| Reastim          | 0,67               | 8,0               | 11,5         |  |  |  |  |
| Ivin             | 0,73               | 8,4               | 11,8         |  |  |  |  |
| Lucy Plus F1     |                    |                   |              |  |  |  |  |
| Water            | 0,72               | 8,4               | 12,4         |  |  |  |  |
| Stimpo           | 0,80               | 9,2               | 13,1         |  |  |  |  |
| Reastim          | 0,74               | 8,5               | 12,4         |  |  |  |  |
| Ivin             | 0,78               | 8,8               | 12,9         |  |  |  |  |

## Biometric indices of tomato seedlings depending on the hybrid and the action of a plant growth regulator (average for years 2017-2018)

The weight of plants for 45 day is an important indicator of growth processes. It greatly affects on the yield of plants after planting to a permanent place. The studies conducted with cherry tomato plants, indicate that the parameters of the above-ground part and the root system depended to a large extent on the action of various growth regulators. Establishment of these parameters was carried out just before planting of the seedlings into open ground. The largest mass of the above-ground part of the seedlings was observed in the variant with the use of Stimpo – 68,1-83,3 g depending on the hybrid. This parameter was lesser in the plants that were treated with Ivin solution – 66.7-81.9 g and Reastim – 63.6-77.5 g. Depending on the growth regulators, the largest mass of roots, during the planting period, was observed in the seedlings which were treated by Stimpo – 15.2-17.7 g, and in control variant by 2.5-5.0 g less. The largest share of the roots to the mass of the overground part was noted in variants using Stimpo and Ivin growth regulators – 21.1-22.1%, in the variant with Reastim this indicator was 19.9 and 21.7% depending on the hybrid.

Applying of the growth regulator helps to increase the area of tomato leaves. During the fruiting period of the eighth truss, the fastest increase in the area of the leaf surface was observed in plants that were treated with the Stimpo solution: in the hybrid Summer Sun F1 – 66.0 thousand  $m^2$  / ha, in Lucy Plus F1 – 65.7 thousand  $m^2$  / ha, which is 2,8 and 2,5 thousand  $m^2$ /ha more in comparison with the control variant.

During the years of the research, the number of fruits on average per plant varied depending on the properties of the hybrid and growth regulator. The highest indicator was noted in the Summer Sun F1 hybrid at plant spraying with Stimpo Growth Regulator – 118.1 pieces /plant, which is 26.2 pieces /plant higher than in the control one. In the studied hybrids, the average weight of the fetus did not significantly change depending on the influence of the growth regulators and was within the range: in the hybrid Summer Sun F1 – 7.2-18.2 g and in the hybrid Lucy Plus F1 – 26.5-27.7 g.

Table 2

The yield capacity of cherry tomatoes is the main indicator and depends on a significant degree on the weight and number of fruits per plant (Table 2).

|                            |                 |            | -                         |                         |  |  |  |
|----------------------------|-----------------|------------|---------------------------|-------------------------|--|--|--|
| Growth                     |                 | to control |                           |                         |  |  |  |
| regulator                  | 2017 2018 avera |            | average over<br>the years | $\pm$ to control t / ha |  |  |  |
| Summer Sun F1              |                 |            |                           |                         |  |  |  |
| Water (control)            | 25,1            | 28,3       | 26,7                      | 0                       |  |  |  |
| Stimpo                     | 27,5            | 32,6       | 30,1                      | +3,4                    |  |  |  |
| Reastim                    | 25,9            | 29,7       | 27,8                      | +1,1                    |  |  |  |
| Ivin                       | 26,6            | 31,5       | 29,1                      | +2,4                    |  |  |  |
| Lucy Plus F1               |                 |            |                           |                         |  |  |  |
| Water                      | 32,3            | 35,7       | 34,0                      | +7,3                    |  |  |  |
| Stimpo                     | 34,4            | 37,8       | 36,1                      | +9,4                    |  |  |  |
| Reastim                    | 32,8            | 36,2       | 34,5                      | +7,8                    |  |  |  |
| Ivin                       | 33,6            | 36,9       | 35,3                      | +8,6                    |  |  |  |
| HIP <sub>05</sub> factor A | 1,02            | 1,02       |                           |                         |  |  |  |
| factor B                   | 1,44            | 1,07       | —                         |                         |  |  |  |
| interaction AB             | 2,04            | 2,05       |                           |                         |  |  |  |

## Cherry tomato yield, depending on the hybrid and the influence of growth regulators, kg / $m^2$

On average over the years of the research, lower yield of cherry tomatoes,  $26.7 \text{ kg} / \text{m}^2$ , was obtained in plants of the control variant without applying of growth regulators. A large significant yield was obtained while Ivin using, which, in comparison with the control, helped to get 2.4 kg and 8.6 kg / m<sup>2</sup> of high-quality cherry tomato fruits aditionally.

For a detailed description of the hybrids of the Cherry tomato, the study of the chemical composition of the fruits is important. Studies have showed that the studied hybrids were distinguished by the dry matter content, even without applying of the growth regulators (5.3-5.4%), as Stimpo and Ivin raised the current index from 0.2 to 0.6%. The mass fraction of sugars was found at the level of 3,12-3,28%, which allowed to provide high flavoring properties of the fruits. Stimpo was notable by the content of vitamin C in the fruits in the hybrid Lucy Plus F1 – 11.7 mg / 100 g. Somewhat lower content of ascorbic acid has been noted in the variants with applying of Reastim – 11.4 mg / 100 g in Lucy Plus F1 hybrid and 11, 52 mg / 100 g in Summer Sun F1 hybrid. The amount of nitrates did not exceed the maximum permissible concentration for the tomato of the covered soil (up to 300 mg / kg).

Thus, in the zone of the Right-bank Forest-steppe of Ukraine it is expedient to grow seedlings of cherry tomatoes of hybrids Summer Sun F1 and Lucy Plus F1 with the use of the growth regulator of Stimpo.

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## STATE-PRIVATE PARTNERSHIP IN THE SYSTEM OF IRRIGATION MANAGEMENT AND SOLVING WATER CONFLICTS IN UKRAINE

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A state-private partnership can be created in the various fields and branches including irrigation and drainage systems management, and it can be realised in the form of concession, joint activity, the creation of organizations and associations of water consumers [1]. One of the effective forms of the state-private partnership in the sphere of water economy can be the transfer of the rights of intro-farm management, objects of engineering infrastructure and drainage to the level of the unions of water consumers ( associations of water consumers). At the same time, management of the main canals, tubes, and water economy objects of inter-regional importance should be conducted by the regional state structures. Therefore, the system of the state-private partnership in the system of water-meliorative activity can be stated as mutual cooperation of the state bodies with private partners [2].

Associations are not a new organizational and judicial form for the countries of the world, there are such unions of land-users and water consumers in many countries, and the unions proved their high efficiency and capability to conduct the efficient water resources and meliorative systems management on practice. However, the experience of many countries, which had already introduced the state-private partnership in the system of water economy by the creation of water consumers association, is actual for Ukraine. The governments of these countries conducted active work on the development of the necessary legislative and normative basis for the creation of water consumers associations, determination of their functions and tasks. However, the hopes of the governments on the effective work of the water consumers associations was not justified everywhere. Every country had typical financial problems – associations did not have enough fundings to maintain and

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exploit meliorative systems, hydrotechnological constructions, and pump stations. According to the laws, associations of water consumers are not profitable unions, however, this position had not been sufficiently stated in the laws that led to the occurrence of the conflicts of interests between the associations and financial structures [3; 4].

The charge for the irrigation water supply was not sufficiently substantiated and very low that did not allow to form the budget of the associations. Agriculture continued to use old cultivation technologies of crops, and this did not allow to increase the yields on the irrigated lands. Water losses from the irrigation systems did not decrease either because of low coefficient of efficiency, no sufficient funding was collected for the reconstruction and modernization of the irrigation systems, and expenditures from the state budget for the maintenance and exploitation of the irrigation systems and water economy objects did not decrease [5]. Besides, associations of water consumers did not feel as valuable partners of the state bodies in the management of irrigation systems and water resources.

The efficiency of water resources and water economy management depends on the introduction of the principles of integrative water resource management. To introduce these principles considerable efforts should be done not only by the state and local management bodies but also by the organizations, which supply farms with irrigation water, and water consumers – farmers. In the annual budget of the country it is necessary to put considerable funding's for the realization of these principles but access to the funding's should have only those farmers, who unite into associations or cooperatives of water consumers by the territorial principle.

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## THE MODIFICATION METHOD OF CORRECTION **OF HYGIENIC BEHAVIOR OF HONEYBEES**

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One of the most important ways of preventing from the honeybee brood diseases is to stimulate the reserve protective properties of bee colonies. Hygienic behavior of honey bees is a method of a colony self-defense, characterized by the removal of sick or damaged larvae on the frames with a brood and is performed by the worker bees [1, p. 226-227; 2, p. 4].

It is known that the hygienic behavior is formed by a breed peculiarity, colony strength and natural or artificial stimulation by feeding [2, p. 74-81].

In our time, it has become important to pay attention to the natural protective mechanisms of bees. In addition, the use of various chemotherapeutic agents is hazardous to the environment and beekeeping produce. While studying the bee brood diseases and having a lot of drugs, we consider it necessary to work out some rational approaches to the natural stimulation of the reserve properties of bee colonies that could influence the spread of bee diseases [3].

The assertion that it's possible to reduce the sickness rate and the application of the therapeutic agents due to the hygienic ability of bees is being checked by a lot of scientists According to the classification, a bee colony is considered hygienic if it is able to remove 90% of the affected brood within 24 hours (other authors claim 70% barrier). If a bee colony removes less than 40-70% of the cells on the brood frame it is considered a critical hygienic ability [4, p. 169-186]. It's possible to strengthen the hygienic behavior of bees through the application of stimulants.

The method of intensification of the natural protection of bees by means of correction of feeding methods hadn't been used. The efficiency of this method was proved and patented in the previous studies [5, p. 4].

The "modified method" of feeding up the bee colonies consists in the simultaneous combination of the aerosol spraying and natural feeding of the stimulants. This method has been investigated on the drugs that may lose their relevance due to the termination of their licensing in Ukraine [5, p. 4].

Therefore, the purpose of our research has become a comparative assessment of the hygienic behavior of bees where such combined feeding technique as 50% sugar syrup without stimulants was applied.

The experiment was carried out on the bee colonies of an aboriginal Ukrainian breed with the queens aged 2 years on a private apiary of Sumy district in April 2018.

The bees are kept in the multiblock hives. The honey flow takes place in the forest and meadow areas with an average level of flowering meliferous plants. Six strong

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bee colonies (7–8 beeways) and 6 average bee colonies (with 4–5 beeways each) were formed and divided into three groups. Of these, the first experimental group (D1, D2) (formed by two strong and two average bee colonies) received 50% sugar syrup in a dose of 1 ml per 100 ml per beeway in the feeders five times within two weeks in all groups except for the experimental one (K1, K2). In the second experimental group (M 3, M 4) the sugar syrup was used in a "modified way", i.e., the part of a single syrup dose was sprayed from both sides onto the dry honeycombs and with some beebread and honey, the other part was fed up.

Three weeks after the brood appeared, the comparative evaluation of the strength of the bee colonies was made and the hygienic behavior was evaluated by a special test. So, one honeycomb with a sealed brood was chosen in each colony and a segment sized 5x5 cm, equal to 100 cells was marked. There the perforations of cells were made and they were put into the hive again. In 24 hours the number of cleaned cells was estimated. The evaluation criterion of hygienic behavior of bees is: high – more than 95%, sufficient – 90-94%, medium – 80-89%; non-hygienic behavior – below 70-79% [7; 13].

Thus, the application of syrup within April in experimental group 1, on the average, facilitated colony strengthening per 1 beeway compared with monitoring. In experimental group 2 - per 2 beeways (Figure 1).



Figure 1. The correlation of strength of bee colonies by different methods of the sugar syrup application: E 1, M 1, C 1\* – groups with average bee colonies; E 2, M 2, C 1\*\*-groups with strong bee colonies. "E" - the experimental groups by the feeding method of syrup application; "M" - the experimental groups by the "modified method" of syrup application; "C" - the control groups without feeding with syrup

As a result of the visual comparison of bee behavior during the application of the modified method of feeding it was stated that aerosol spraying enforced bees to take fodder honey, accelerated the obtaining of extra nutrition to the brood and queen, and contributed to cleaning the hive from the dead larvae.

As a result of the "perforation" test it was found out that the strong colonies that received extra nutrition due to the modified method performed sanitary-hygienic functions at 82-87%; the colonies receiving syrup in a simple way - at 70-78%; the colonies under control had 64-69% degree of cleaning (Figure 2).



Figure 2. Evaluation of hygienic cleaning of bee colonies by the "perforation test" in different methods of expemental feeding with syrup and control: E\*, M\*, C\* - for explanation, see Figure 1

Parallel with the revision in April, it was found out that before the beginning of the experiment, the degree of Varroozis affection of experimental bee colonies and the colonies under control in weak families was about 2-3%. The presence of motley brood was 3-4 cells per 100 cells with a brood. Then, after extra nutrition by the modified method the presence of motley brood was -1-2; by feeding -2-3; under control -3-4 cells.

Thus it has been established that the "modified method" combining feeding and aerosol spraying of honeycombs with honey, beebread and honeycombs for the future brood, contributes to performing basic vital functions of a bee colony – increasing its strength and hygienic behavior.

The combined feeding technique for extra nutrition of bees compared with the standard one without application of stimulants improves the hygienic behavior of bees by 9-12%, but withot extra nutrition – by 18%, which is an important chain in the prophylaxis of diseases of a honeybee brood.

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## CLASSIFICATION OF THE SOURCE MATERIAL OF TOBACCO VARIETIES CULTIVATED IN THE CENTRAL PART OF THE FOREST-STEPPE OF UKRAINE BY THE MULTIVARIATE STATISTICS METHOD

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Tobacco is an important technical crop. Until recently, it was one of the most profitable crops in Ukraine thanks to the highly productive domestic varieties, with a profitability level of 28–40 %. However, over the years of independence of our state, there has been a tendency towards a decline in tobacco production. The main reason of the tobacco production decline is the reduction of cultivating areas in the Zakarpatti, Prydnistrovyi and the loss of a unique cultivation zone in the Crimea. According to the official statistics, tobacco production in Ukraine serves the industry needs for only 0,15 %. The work of tobacco factories depends entirely on the import of raw materials from abroad [1, p. 23].

The strategic task of the tobacco industry is to increase the volumes of own tobacco production, which is possible only due to the introduction of new competitive varieties of domestic breeding with the improved quantitative and qualitative productivity indices [4, p. 78].

Therefore, the main task of the crop breeders is to create the early-ripening, high-yielding varieties and hybrids of tobacco with high quality of raw materials, which depend primarily on the genetic potential of the source material and conditions of cultivation, for cultivating in the conditions of the Central Forest-Steppe of Ukraine [2, p. 119].

The aim of the research was to evaluate the tobacco source material as a complex of major morphological and biological features (plant height, number of leaves, leaf size (length and width), yields of raw materials and the growing season duration) and to group the genetically close varieties into separate clusters, which will enable to

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predict the transgressive segregation level of the hybrid progeny by the genetically different forms crossing [3, p. 67].

Experimental researches were carried out at the Research Station of Tobacco Growing of the National Academy of Agricultural Sciences of Ukraine, (Uman, Cherkasy region) during 2017–2018. The source material for the research was 26 varieties of tobacco of various ecological and geographical origins.

Using the STATISTICA 10.0 computer program, all the varieties were divided into six clusters.

The first cluster includes two varieties: Krupnolystyi 52 (C. 19) and Gostrolyst Rubin (C. 21) (Figure 1). These varieties are similar to each other for the morphological characteristics: the height of plants – 254–268 cm (very tall plants), the number of leaves – 22–24, the leaf length – 54–55 cm and the leaf width – 33–34 cm. The yield of raw material of the variety Krupnolystyi 52 (C. 19) was 4,1 t/ha, and Gostrolyst Rubin (C. 21) – 5,4 t/ha. The growing season duration was within 102–114 days.

The second cluster was formed from six varieties: American 1 (C. 12), American 165 (C. 13), Trapezond Beregovyi (C. 17), Trapezond Platana (C. 18), Virginia Joyner (C. 24) and Samsun Krasnodar (C. 26). All the varieties are late ripening with a vegetation period of 114–120 days. The height of the plant varieties of this cluster was within the range of 163–180 cm (medium-grown plants). In the four varieties, namely: American 1 (C. 12), American 165 (C. 13), Virginia Joyner (C. 24) and Samsun Krasnodar (C. 26) the number of leaves was in the range of 20–25, in the two varieties Trapezond Platana (C. 18) and Trapezond Beregovyi (C. 17) – 16–17, the leaf length varied within 42–48 cm, width – 24–29 cm. In the Samsun Krasnodar variety the leaf length was 37 cm and the width – 23 cm. The yield of raw materials of these varieties was at the level of 2,3–2,4 t/ha, with the exception of two ones, namely: Trapezond Plata (C. 18) and Trapezond Beregovyi (C. 17), which indices were 1,3 and 1,9 t/ha, respectively.

The third cluster was formed by the varieties Berley 38 (C. 6) and Berley 46 (C. 7). The plant height of these varieties was within the range of 158-163 cm (short-growing. The number of leaves was 21-23. The leaf length is 53-54 cm and the width is 32-34 cm. The yield of the raw material is 3,7 and 4,0 t/ha. The average vegetation period over the research years in both varieties was 104 days.

The fourth cluster included six varieties of tobacco: Ternopilskyi Perspektyvnyi (C. 4), Berley 9 (C. 8), Trapezond (C. 10), Sobolchskyi 33 (C. 11), Berley 7433 (C. 14) and Samsun Crimea (C. 25). Four varieties were distinguished as the tall ones: Ternopilskyi Perspektyvnyi (C. 4), Berley 9 (C. 8), Trapezond (C. 10) and Samsun Crimea (C. 25) with the indices of 188, 195, 199, 193 and 200 cm respectively, and one as a medium-grown variety – Berley 7433 (C. 14) – 178 cm. The number of leaves was 23–25 in such four varieties as Ternopilskyi Perspektyvnyi (C. 4), Berley 9 (C. 8), Trapezond (C. 10) and Sobolchskyi 33 (C. 11) and the varieties Samsun Crimea (C. 25) and Berley 7433 (C. 14) had 15-19 leaves. The leaf length in all the varieties varied in the range of 46–57 cm and the width was 27–32 cm. The yield of raw materials in these varieties was at the level of

3,0-3,7 t/ha, except for the variety Berley 7433 (C. 14), which index was 4,5 t/ha. The growing season duration was 100-105 days.



Figure 1. Euclidean distances between the tobacco varieties of different clusters (average for 2017–2018)

Seven tobacco varieties are typical for the fifth cluster, such as: Ternopilskyi 7 (C. 2), Ternopilskyi 14 (C. 3), Spectr (C. 9), Berley White (C. 15), Bravyi 200 (C. 16), Gostrolyst Giant (C. 20) and Virginia Joyner (C. 24). All tobacco varieties were very tall, with a plant height of 209–224 cm except for the Virginia Joyner variety (C. 24), which height was 177 cm (medium-grown). The number of leaves varied within 20–24. The leaf length for all varieties was 54–57 cm and the width was 32–35 cm. The Virginia Joyner variety (C. 24) was an exception with a leaf length of 47 cm and a width of 25 cm. The growing season duration was 100–108 days, only by the variety Virginia Joyner (C. 24) 118 days. The high yield of raw materials was typical for the varieties: Bravyi 200 (C. 16), Gostrolyst Giant (C. 20) and Gostrolyst Yubileinyi New (C. 23) which indices were 5,3 and 5,6 t/ha, and the average yield was typical for the varieties Spectrum (C. 9), Ternopilskyi 7 (C. 2) and Berley White (C. 15) – 4,1, 4,2 and 4,9 t/ha, respectively. The varieties Virginia Joyner (C. 24) and Ternopilskyi 14 (C. 3) were less productive, with a yield of 2,3 and 3,6 t/ha.

The sixth cluster was formed by the three varieties: Virginia 27 (C. 1), Temp 321 (C. 5), and Gostrolyst Yubileinyi New (C. 23). These varieties are morphologically similar. Plants of these varieties are tall, with a height of 203-215 cm. The number of leaves was 22-25. The leaf length varied within 52-54 cm, width -32-35 cm. The growing season duration of the varieties Virginia 27 (C. 1) and Temp 321 (C. 5) was 117-121 days and of the variety Gostrolyst Yubileinyi New (C. 23) -102 days.

According to the raw material yield, the Gostrolyst Yubileinyi New variety (C. 23) was the leader with an index of 5,6 t/ha. The varieties Temp 321 (C. 5) and Virginia 27 (C. 1) had the indices 3,6 and 4,2 t/ha respectively.

Thus, the conducted cluster analysis of the source material, based on a set of main features, enables early identification, distribution and selection of parent components of hybridization to create the new competitive domestic tobacco varieties in the early stages of the selection process.

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## SEED PRODUCTIVITY OF ALFALFA DEPENDING ON THE METHODS OF CROP TENDING

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In solving the problem of increasing and stabilizing the production of feed protein in Ukraine, the yield enhancement in alfalfa as a leading forage legume culture is of great importance. Until recently, the level of seed yield (70-85% of the potential) of this crop has remained low and unstable [1, p. 32].

By fixing nitrogen from the air, alfalfa leaves, together with root and crop residues, up to 150-170 kg/ha of biological nitrogen in the soil. An increase in the planting acreage of alfalfa will enable to preserve the deficit-free balance of humus in soils and their fertility.

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All operations of the single technological process of cultivation of seed alfalfa create the preconditions for soil improvement in crop rotation, reducing populations of harmful insects, weeds, pathogens and accumulation of useful organisms [2, p. 236].

The loosening between rows improves the conditions of the growing season, temperature, air, water, nutrients and microbiological soil regime.

In the Forest-Steppe and Steppe, loosening prevents the formation of deep cracks, loosing moisture, and reduces the soil overwarming. An increased gas exchange in the soil improves the activity of free-living nitrogen-fixing bacteria, beneficial microorganisms, nitrification processes, etc.

In the areas of sufficient moisture on light loam and sandy loam soils, the main objective of inter-row cultivation is the protection from weeds and the creation of optimum plant stand that increases the seed productivity of alfalfa [3, p. 112].

In the development of new improved technology of the production of alfalfa seed, a particular focus should be placed on wide-row spaced planting; measures to increase the number of wild pollinators; the protection of crops from pests and weeds; the modes of use of seed plant stand; reduction in loss of seeds at harvest due to the technological methods of crop tending [4, p. 15].

Phosphoric fertilizers significantly increase the seed productivity of alfalfa. They have a positive effect on the growth of the root system, the development of top, contribute to the formation of a greater number of generative stems, flowers, beans and increase winter hardiness [5, p. 130].

The goal of our research is to determine the effect of inter-row loosening on the seed productivity; to study the effect of the inter-row cultivation on the formation of vegetative mass of plants, the passage of the main phases of alfalfa development.

The experimental design: 1) alfalfa according to the conventional technology (check I); 2)  $P_{90}K_{90}$  to the basic application (check II); 3)  $P_{90}K_{90}$  +early cutting down + 2-time inter-row loosing to a depth of 5-6 and 10-12 cm; 4)  $P_{90}K_{90}$  + 2-time inter-row loosing to a depth of 5-6 and 10-12 cm; 5)  $P_{90}K_{90}$  + 3-time inter-row loosing to a depth of 5-6, 10-12 and 20 cm; 6)  $P_{90}K_{90}$  + 2-time inter-row loosing to a depth of 5-6, 10-12 and 20 cm; 6)  $P_{90}K_{90}$  + 2-time inter-row loosing to a depth of 5-6, 10-12 and 20 cm; 6)  $P_{90}K_{90}$  + 2-time inter-row loosing to a depth of 5-6 and 10-12 cm; 7)  $P_{90}K_{90}$  + 2-time inter-row loosing to a depth of 5-6 and 10-12 cm; 7)  $P_{90}K_{90}$  + 2-time inter-row loosing to a depth of 5-6 and 10-12 cm; 7)  $P_{90}K_{90}$  + 2-time inter-row loosing to a depth of 5-6 and 10-12 cm; 7)  $P_{90}K_{90}$  + 2-time inter-row loosing to a depth of 5-6 and 10-12 cm; 7)  $P_{90}K_{90}$  + 2-time inter-row loosing to a depth of 5-6 and 10-12 cm; 7)  $P_{90}K_{90}$  + 2-time inter-row loosing to a depth of 5-6 and 10-12 cm; 7)  $P_{90}K_{90}$  + 2-time inter-row loosing to a depth of 5-6 and 10-12 cm + the hilling-up of plants in the budding stage.

The main attention during the tending of seed alfalfa crops is paid to the formation of healthy plants and the creation of favorable conditions for flowering and fruit formation.

The duration of the period from the beginning of spring aftergrowing to the beginning of flowering in the second year of life was stable in all variants of the experience and amounted to 85 days. The only exception was the option of 3-106 days. This figure exceeded the values in other variants by 24.7%.

The period from the beginning of spring aftergrowing to seed maturation of seed alfalfa of the second year of life in our experience lasted from 149 to 157 days. However, as with the previous indicator, all variants were the same, except for the third one -157 days. This difference was 5.4%.

The number of stems at the time of spring aftergrowing, depending on the experiment variant, ranged from 130-144 pcs that significantly influenced the further productivity of crops. The difference between the experiment variants ranged from 1.5% to 10.8%. The greatest number of stems was generated in the variant 5 ( $P_{90}K_{90}$  + 3-time inter-row loosing to a depth of 5-6, 10-12 and 20 cm) and, vice versa, the minimum was obtained in the variant 4 ( $P_{90}K_{90}$  + 2-time inter-row loosing to a depth of 5-6 and 10-12 cm).

The analysis of the formation of the number of alfalfa stems after harvesting has revealed that the lowest value of the indicator is in the variant 3 - 190 pcs., and most of all – in the variant 7. The difference in the number of stems after harvesting is 17.8%.

Important in the seed production of alfalfa is the creation of an optimal feeding area for plants, in which fewer flowers would fall off, and a higher seed yield would be formed. The weight of 1000 seed alfalfa is an important element of the crop structure, which affects the sowing quality of seeds, germination energy, equalization of crops, seed viability, and adjusts the seeding rate. On average in the variants during the two years, the highest weight amounting to 1000 seeds was obtained in the variant 7 - 1.9 g. The minimum value of the indicator was 1.45 g – in the variant 3. Therefore, this indicator significantly depends on the methods of crop tending.

Improving the technology of production of alfalfa seeds enables to increase the yield of seeds of this crop. The main indicator of the efficiency of production as the yield of seeds in our experience significantly depends on the weather conditions of the year and methods of crop tending.

The average yield of seeds ranges from 1.08 c/ha to 1.65 c/ha. The greatest deviation is observed in the check option 1, and in check 2 - 0.48 c/ha or 41.0%.

The higher seed yields of alfalfa are possible with crop tending, which includes fertilizing  $P_{90}K_{90}$  + early cutting down + 2-time inter-row loosing at a depth of 5-6 and 10-12 cm.

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## CHARACTERISTICS AND ASSESSMENT OF BIOLOGICALLY UNSTABLE FOREST PLANTATIONS OF VINNYTSIA USING INTERNATIONAL METHODOLOGY OF ICP-FORESTS

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Monitoring of forest plantations having damaged stability is a system for monitoring, estimating and forecasting changes in the forest ecosystems caused by the influence of negative factors. Negative factors affecting forests can be classified by the nature and origin, period and duration, nature of effect, scale and scope of influence, as well as by their rate and consequences [1, p. 15].

During the research, we examined pine, oak, hornbeam and beech forest associations. The sites for monitoring were located in these forest plantations. The sites intended for monitoring had about 100 wood species, for which indicators were determined according to the international methodology of ICP-Forests. For certain trees, the diameter, crown length in%, Craft class (position of the tree in the forest stand according to its development), defoliation, dechromation, crown density in % on the trial siteswere determined (Table 1).

Table 1

| Species          | Diameter,<br>cm | Length of<br>the crown,<br>% | Craft<br>class | Defoliation,<br>% | Dechromation,<br>% | Crown<br>density,<br>% |
|------------------|-----------------|------------------------------|----------------|-------------------|--------------------|------------------------|
| Common<br>pine   | 24.0            | 27.3                         | 2.2            | 23.1              | 8.0                | 62.7                   |
| Common<br>oak    |                 | 35.0                         | 2.0            | 15.0              | 10.0               | 70.0                   |
| Beech            | 17.9            | 48.3                         | 2.6            | 13.6              | 2.5                | 73.2                   |
| Common<br>spruce | 17.3            | 26.1                         | 2.3            | 21.3              | 0.0                | 73.6                   |

## Generalizeddata obtained on the monitored sites in the forest plantations of Vinnitsa region

Assessment of the state of forest plantations was carried out based on the established indicators of defoliation and dechromation of the monitoring methodology that are given in Table 2.

According to the table, forest plantations with the rate of defoliation and dechromation of up to 10 % are considered to be undamaged, 11-25% – conditionally damaged, 26-60 % – moderately damaged, 61-99 % – heavily damaged. According to the given grouping, pine plantations should be classified as moderately damaged (rate

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of defoliation and dechromation exceeds 25 %), spruce, common oak, common beech, common hornbeam can be treated as conditionally damaged. The state of pine and spruce can be characterized as the worst. Since these forest plantations are adjacent to the city of Vinnytsia and motor transport is the main source of pollution, probable deterioration of their state is caused by the effect of aero-anthropogenic emissions. Coniferous breeds are less resistant to the effects of pollutants, so we analysed the content of heavy metals in the components of forest ecosystems. For the first time, the research on the content of heavy metals in the needles of common pine and common spruce was carried out [2, p. 27].

Table 2

| Damage rate | Characteristics<br>of the forest status | Rate of defoliation and dechromation, % |  |
|-------------|---|---|--|
| 1           | undamaged                               | 0-10                                    |  |
| 2           | conditionally damaged                   | 11-25                                   |  |
| 3           | moderately damaged                      | 26-60                                   |  |
| 4           | heavily damaged                         | 61-99                                   |  |

## Characteristics of plantations according to the methodology of the international monitoring program

In order to evaluate the content of heavy metals in the components of forest ecosystems, during the research we have selected the samples of needles of common pine and common spruce to estimate the content of heavy metals. Samples were selected in summer, analysis was carried out in the laboratory. Data on the content of heavy metals are given in Table 3.

Table 3

| No | Name of the indicator | Unit of measurement | Method of testing             | Maximum<br>allowable<br>concentra-<br>tion | Actual<br>value in<br>spruce | Actual<br>value in<br>pine |
|----|-----------------------|---------------------|-------------------------------|--|------------------------------|----------------------------|
| 1  | lead                  | mg/kg               | State<br>standard<br>30178-96 | 5.0  | 0.338                        | 0.329                      |
| 2  | cadmium               | mg/kg               | State<br>standard<br>30178-96 | 0.3  | 0.112                        | 0.111                      |
| 3  | copper                | mg/kg               | State<br>standard<br>30178-96 | 30.0                                       | 1.605                        | 0.963                      |

## The content of heavy metals in the needles of common spruce and common pine

According to the table, lead, cadmium and copper are accumulated in pine needles in the following concentrations: 0.338, 0.112, 1.605 mg/kg. The content of these elements in spruce is as follows: lead - 0.338, cadmium - 0.112, copper -1.605 mg/g. Evaluation of the content of heavy elements at maximum allowable concentrations (MAC) indicates the absence of significant accumulation of these elements in the tree needles. However, the indicated values of concentrations are given in general for plants. Thus, currently, MAC for the content of heavy metals in the needles of pine and common spruce, which could significantly affect the state of forest ecosystems, have not been determined. Therefore, even these concentrations may, to some extent, worsen the state of forest plantations.

According to the results of the estimation of forest plantations (Table 2), pine forests are characterized by the worst condition (defoliation and dechromationrates are 31.1 %), while spruce forests are slightly better (the rate is 21.3 %). However, the content of heavy metals in the pine needles is higher compared to that one in spruce. This indicates that, along with the impact of aero-anthropogenic emissions, other factors, including abiotic (primarily climatic) and bioticfactors, have a significant influence on the state of the forest ecosystems [3, p. 12].

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## **OPTIMIZATION OF DOSES AND TIME OF MINERAL NITROGEN APPLICATION ON WINTER WHEAT PLANTINGS**

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Grain is of primary importance in supplying the growing number of world population with food, that's why increasing of its production is very significant in many countries. Grain is the main energy source of vital activity of human body. Grain and leguminous crops takes 76% in the structure of foodstuffs [4, p. 7]. Today there are considerable differences between its production and consumption in developing and developed countries. In future the need for grain will not be filled due to the urbanization (for example today 45% of people live in cities, but in 2020 their part will rise to 60%) and improvement of the well-being in the developing countries [5, p. 14]. Winter wheat takes the main place between grain crops. It is cultivated all over the world and is one of the main foodstuffs for nearly 35 % of world population. It provides the population with about 20 % of energy requirements. Winter wheat is one of the main products of world trade.

Under the conditions of north-east forest steppe of Ukraine winter wheat is one of the leading grain crops. But yielding capacity and gross collections of its grain are unstable by years of its cultivation. Prospects of grain crops cultivation are based on improvement of intensive technologies in the sphere of resource saving. We need to ensure the conditions for the development of every separate plant starting from the selection of predecessor, fertilizers, sort and finishing with harvesting. Only in such conditions we can get better realization of genetically valuable characteristics of modern sort resources of winter wheat [3, p. 4].

There are not secondary agro-technical measures in the cultivation technology. To get a high yield of wheat grain you need to do all required works qualitatively and in due time. If you don't do at least one of these works it can lead to decrease of yielding capacity in spite of all your efforts. You should constantly control growth and development of plants directing their power to the formation of necessary structural elements of yield [4, p. 10-11].

Grain crops and wheat in particular need minerals together with other factors of environment (light, warmth, moisture) to have normal growth, development and ripening. Minerals take part in metabolism and formation of organic weight and yield. That's why in order to get high and stable yields of high quality it is significant to select suitable fertilizer. It is especially important for wheat to apply the appropriate doses in optimal time filling the need of plantings in nutrients [5, p. 289].

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One of the main nutritive elements for wheat is nitrogen. Wheat belongs to nitrogen-loving plants. To form 1 kg of grain we need 3,75 kg of nitrogen. During the vegetation period of plants the consumption intensity of nitrate and ammoniacal nitrogen forms is various. The thing is that at the beginning of vegetation the content of carbohydrates of active forms in winter wheat which are necessary for ammonia fixation and protein production is quite low. At later stages of wheat development fructose content in leaves is higher which leads to increasing of ammonium nitrogen uptake [6, p. 10-14].

In Ukraine average amount of applied mineral fertilizers is 30 kg per ha which is much fewer comparing with the USA, Canada, India and the Argentine. Beside insufficient number of applied fertilizers there is quite low effectiveness of nitrogen using in households. For example if we apply 1 kg of nitrogen then grain yield is more on 12-13 kg only whereas the same index in France is 20 kg, in Germany – 20,3 kg. Such a big difference in efficiency of nitrogen using is connected with imperfect schemes of nitrogenous nutrition [6, p. 10-14].

So, by constant price increase for fertilizers in order to get maximal yield growth of winter wheat we should originate the scheme of nitrogenous nutrition which would correspond with physiological needs of a crop in certain soil and climatic conditions.

The researches were conducted in grain and hoed crop rotation of Sumy National Agrarian University. The soil, where our researches were conducted, is typical low-humic black soil. The predecessor of winter wheat was soybean for grain. Agricultural methods of growing were common for conditions of climatic zone. The researches were conducted by the scheme of simple experiment. Crop acreage of lots was 50 m<sup>2</sup>, accounting area was 25 m<sup>2</sup>, frequency – four-time which corresponds with the demands for conducting experiments with grain crops. Rotation of variants in replication was sequential. As an object of the researches we selected the sort Dostatok. Field experiments were done according to generally accepted methods [1, p. 25-120; 2, p. 5-10].

The main criteria as for the rise of grain productivity of winter crops due to the application of nitrogen fertilizers is considerable increase (on 100-200 pieces per m<sup>2</sup> and more) of productive plant stand density (to 556 pieces per m<sup>2</sup> in 2016, to 738 pieces per m<sup>2</sup> in 2017 and 770 pieces per m<sup>2</sup> in 2018). Nitrogen fertilizers application in autumn as an extra nutrition and on frozen soil favoured to the rise of general tilling capacity index: in 2016 - 1,8-2,0, in 2017 - 2,0-2,1, in 2018 - 2,2-2,8.

As a result of positive influence of mineral nitrogen application we determined sufficient increase of winter wheat yielding capacity (Figure 1). Herewith the increase of grain yield varied from 0,14 to 0,62 ton per ha.

The main factors which influenced the efficiency of extra nutrition by nitrogen fertilizers were the time frames of its application and doses. The highest yielding capacity of grain on the average during the years of researches was achieved by autumn dosing in the phase of wheat tillering with the dose  $N_{30-}$  0,65 ton per ha and similar to it three-time dosing by common norm  $N_{60}$  (ground +  $N_{15}$  on frozen soil +  $N_{30-}$  stem elongation +  $N_{15}$  – ear formation) – 0,64 ton per ha. On other variants of the researches the doses by  $N_{30}$  and  $N_{60}$  on frozen ground and in the phase of stem

elongation ensured fast similar levels of yield. The dosing by the same norms in the phase of ear formation led to the decrease of yielding capacity in comparison with other variants.



## Figure 1. The influence of doses and time of nitrogen fertilizers application on yielding capacity of winter wheat grain, 2016-2018

On the average during the years of researches the most effective dose as for the payback of mineral fertilizers was the dose 30 kg per ha of nitrogen primary nutrient which were applied as autumn fertilization. In this case 1 kg of nitrogen primary nutrient applied with fertilizers ensured additionally 20,6 kg of winter wheat grain. This variant gave the maximal yield during the years of researches -5,05-8,25 ton per ha.

In such a way growing winter wheat using minimal doses of main fertilizer, autumn fertilization of planting by dose  $N_{30}$  favoured to significant increase of yielding capacity of grain and growth of payback of applied fertilizers.

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## **INCREASING THE PRODUCTIVITY OF HUNGARIAN SAINFOIN** BY OPTIMIZING THE BASIC TILLAGE METHODS AND DEPTH

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Among the perennial herbs that are grown mainly in most natural and climatic zones of Ukraine, one of the leading places belongs to sainfoin. In particular, Hungarian Sainfoin is a good nitrogen fixer of agronomical importance, which has an erosion preventive property, and is the best precursor for grain and forage crops. It has the advantage over other perennial leguminous herbs which is in greater resistance to adverse growing conditions, and is a less demanding plant [2, p. 7].

Therefore, the cultivation of sainfoin is a very important direction of greening and biologization of crop production, a reserve for successful solution to the problems of the production of high-quality feed and the improvement of soil fertility being of particular relevance [3, p. 81-85].

With the application of a technological approach to the intensification of agriculture, the environment is mainly polluted with toxic substances, soil erosion is significantly distributed, the species diversity of useful flora and fauna is significantly reduced, the risk of mass destruction of agrocenoses by diseases and pests increases.

The analysis of data in this regard shows that the strategy of comprehensive intensification of farming systems is vulnerable. It is increasingly evident that such strategy has both resource and environmental limitations [4, p. 47].

The guarantee of obtaining environmentally friendly and biologically complete products is the introduction of perennial legumes into the structure of the acreage of field, feed and special crop rotations, solutions to the problems of protein, the transformation of air nitrogen into plant protein due to bacteria that fix nitrogen, enriching the soil without the application of mineral nitrogen fertilizers, biological loosening and soil structuring by the root system of plants.

With its forage properties sainfoin is considered to be one of the best fodder grasses. All animals willingly eat it both in the form of green forage and hay. While

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feeding green mass of sainfoin, animals do not have tympanitis (gastric flatulence), which often happens when using pure alfalfa and clover [1, p. 22].

The growing of sainfoin is a very important direction of the crop production greening, a reserve for successful solution to the challenges connected with both the production of high-quality feed and the improvement in soil fertility.

The obtaining of full-fledged sprouts, the optimal growth and development of sainfoin plants depend on a favorable combination of hydrothermal and soil conditions, the individual response of the crop to environmental factors, as well as the proper state of the seed layer. It is commonly known that the basic tillage, which is performed by different types of tools and depends on the conditions of crop growing, has a significant influence on the state of the arable and sowing layer of the soil.

The selection of soil treatment system for each crop should be carried out taking into account the soil and climatic conditions and depend on the predecessor, the biological characteristics of the cultivated crop, the degree and nature of the field contamination, surface relief. In modern conditions, the classical ploughing in crop rotations is not dominant. It is mostly differentiated with the use of plowing, disking, and chisel-plow tillage for individual crops and its differentiation at a depth from 6-8 to 40-45 cm.

The basic soil tillage has a direct impact on the change in its structure, the surface density and nature, effects the infiltration and evaporation of moisture. Soil density is one of the main factors of fertility as it characterizes the whole complex of physical conditions of the soil [5, p. 9-11].

The combination and solution of the above problems have caused the need to study the influence of methods and depth of the basic soil tillage on the growth and development of Hungarian Sainfoin.

The tillage systems change periodically. Some systems are replaced by others, but the fundamental types of basic soil tillage, such as plowing and plowless tillage remain.

The effective impact of tillage on the soil is enhanced when its depth, methods and measures are carried out in a scientifically sound sequence and in close cooperation with all parts of the farming system [6, p. 5-11].

Given the above, the methods and depth of basic tillage, and their influence on its agrophysical condition are an integral component of the process of obtaining highquality forage and, therefore, have caused the need to conduct research and proper study of these relevant issues.

Among the perennial grasses that are grown in the North-Eastern Steppe of Ukraine, one of the leading places belongs to sainfoin. The high nutritional value of forage and positive aftereffect in crop rotations, that is the accumulation of biological nitrogen in the soil, make conditions for the wide spread of this crop.

The research to establish the impact of methods and depth of basic tillage on the growth and development of Hungarian Sainfoin was carried out in the Institute of Agriculture of the North-East of the National Academy of Science of Ukraine, Sumy region during 2015-2016. The experimental design included the following options: 1. Combined tillage (KLD-2.0) – 14-16 cm (check), 2. Combined plowless tillage

(KLD-2.0) - 10-12 cm, 3. Combined plowless tillage (AG-2.4-20) -10-12 cm, 4. Direct sowing.

According to the research results, a significant impact of the methods of basic tillage has been established on the productivity of sainfoin. The collection of nutrients, namely: feed units, digestible protein, forage units, is the highest under plowless tillage (KLD-2.0 to a depth of 14-16 cm) and is equal to 7.75; 0.65; 7.13 t/ha, respectively.

In terms of yield of green mass, the combined tillage (KLD-2.0) to a depth of 14-16 cm exceeded the combined plowless tillage (AG-2.4-20) to a depth of 10-12 cm by 8%, the combined plowless tillage (AG-2.4-20) to a depth of 10-12 cm – by 20%. Under no-tillage (the option of direct sowing), the yield of green mass was lower by 26% compared to the check option.

It has been found that the maximum indicators of the sainfoin growth and development are obtained under the combined tillage (KLD-2.0) to a depth of 14-16 cm – the plant stand density is 188 plant  $pcs/m^2$ , a number of stems are 397 pcs/ha, plant height is 101.4 cm. The less favorable conditions by biometric indicators are observed under direct sowing.

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## ADAPTATION OF COWS OF SCHWYZ BREED IN ENGINEERING AND BIOLOGICAL SYSTEM "MAN – MACHINE – ANIMAL"

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The main problem of the modern dairy cattle - is raising the level of milk productivity due to increased efficiency of the use of feed nutrient [1]. At the same time, is a topical issue the problem of adaptation of imported livestock to new ecological and climatic conditions, intensive technology of exploitation and ensuring feed [2; 3]. It is necessary to provide animals with high quality feed. The organization of normalized feeding is determined, first of all, by the need for dry matter. The ration is considered to be balanced if the need for organic nutrients (carbohydrates, proteins, fats), macro- and micronutrients, vitamins is provided with a set of feeds, and if necessary, enriched with additives [4; 5].

The research was carried out at the industrial complex for the production of milk on cows of Schwyz breed (Big brown Swiss), which were formed in three groups: group I – animals imported from Austria in the spring; group II – animals imported from Austria in autumn; group III - animals imported from the Sumy region of Ukraine. Experimental animals were on 2-3 months of lactation. Milking was carried out on a milking installation of the type "Parallel" three times a day with an 8-hour interval. Suspended part of the milking machine DeLaval MC 53 a weight of 2.1 kg with glasses of technology Top-Flow, provided a stable vacuum. The 360 ml collector and the pulsator DeLaval EP 100 provided the alternate milking the left and the right half of the udder of cows.

The daily ration of feeding lactating animals was quite structured. In the structure of the ration on rough feeds accounted for 12.0 %. Rough feeds were represented by two types of straw and hay of Sudanese grass. At the same time in the fodder mixture was introduced a very nutritious haylage from bean grass alfalfa and corn silage. Daily was giving the hay of 20.19 kg, the silage weight was 6.52 kg, which was less than 3.1 times. The share of concentrated feed in the ration of lactating cows accounted for 43.8 % [6]. For protein supplementation in the ration, the soybean meal was introduced at 1.59 kg.

The total weight of the full-fledged feed mixture was 42.2 kg for each animal. In the ration, the dry substance did not exceed 24.52 kg, which was 3.91 kg per 100 kg of live weight of cows. The dry substance of the ration for Schwyz cows was provided with raw fiber at the level of 22,9 %.

In the conducted studies, it was clearly observed that experimental groups of animals were characterized by an extended lactation period that ranged from 364.1 to 372.4 days. Big brown Swiss cows of the III (control) group, for which the weather-

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climatic conditions of the Ukrainian steppe were a place of ecological origin, showed a high level of productivity and produced 9023.0 kg of milk for the entire lactation period. At the same time, under identical conditions of operation, Schwyz breed cows of the second group had a significantly higher milk-yield, which was on average 11094.0 kg, which was more by 18.7 % (P<0.001). The highest level of productivity was observed of the cows of the I group, which received 12126.8 kg of milk during the entire lactation period, exceeding the index of analogues of the II group of 8.5% (P<0.001), while the value of the III (control) group was 25.6 % (P<0.001).

It is known that the index of insemination can act as a catalyst for adaptive plasticity of the organism of cows. In these studies, the animals of the third (control) group were characterized by the lowest indicator, which was an average of 2.83 units. In the same conditions of exploitation, significantly higher index of insemination index were observed of Swiss breed cows of II group, in which it was higher than the analogues of the III (control) group by 13.98 % (P<0.001) and was about 3.29 units. The highest indicator of the number of inseminating per one fertilization was characterized by the experimental livestock of I group, in which the index of insemination was 3.80 units. This value was greater than that of analogues of group II by 13.42 % (P<0.001), and control cows of II group – by 25.53 % (P<0.001).

It was quite natural that the reproductive ability coefficient of lactating cows was directly dependent on the index of insemination. It is no coincidence that, the animals of the third (control) group, in which he amounted to an average of 0.93, were the best reproductive ability. Significantly lower reproductive ability was observed in experimental animals of I and II groups, an average of 0.87 and 0.88, respectively.

In accordance with the technological requirements for milking of Swiss breed cows on the milking installation of the "Parallel" type, the sanitary-preparatory operations are reduced to the immersion of each nipple udder in a glass with washing solution (t=35-40° C), wiping it with a dry towel, dispensing the first drops of milk on the floor and connecting milking cups. Unconditionally reflex stimulation of the receptor apparatus of udder before milking is quite short-term, since it does not exceed 30.9 seconds. In addition, all unconditioned stimuli are performed discretely, therefore, are significantly expanded in time. That is why, on conditional reflex stimulation of the lactation center of cows accounts for 88 % of the time, and on unconditionally reflex stimulation of the receptor apparatus of the udder tissues – only 12 %.

It was established that milking of 20 cows at the milking machine type "Parallel" spent on average 11 minutes and 9 seconds. That is, the service of one cow requires 33.5 seconds, and 40 cows - 29.9 seconds.

Researches have shown that after short-term unconditioned-reflex stimuli of the receptor apparatus of the udder, the experimental cows showed high readiness for milking. Experimental groups of cows were characterized by a high and almost identical one milk-yield, which did not drop less than 10.9 kg, although not exceeding 11.8 kg. To collect of this amount of milk by the milking machine was spent on average from 4.6 to 4.8 minutes. Automatic milking the last milliliters of milk started

with a significant reduction in milk flow and lasted an average of 15-17 seconds, after which the milking machine automatically removed from the udder.

Experimental groups of Schwyz breed cows differed in terms of the intensity excretion milk from the udder by the milking machine. Thus, the average intensity of milk excretion in cows of the (control) group of Sumy breeding was 2.4 kg/min. In cows of the third group of Austrian breeding imported in the fall, the average intensity of milk excretion was almost the same, and it was 2.5 kg/min. The relatively high average intensity of milk excretion was characterized by the animals of the second group of the Austrian selection imported in spring in which this index was 2.8 kg/min, which was higher than the values of the analogues of the III group by 10.7 %, with the probability of a difference of P<0.05, and the index of the I (control) group – by 14.3 % with the probability P<0.01.

In this case, all experimental animals showed high rates of the highest indicator of milk excretion. Thus, its maximum intensity in Swiss breed cattle of the (control) group of Sumy breeding was 3.7 kg/min, while in animals of the III group this figure was greater by only 7.5 % and did not exceed 4.0 kg/min. Good indicator of the maximum intensity of milk excretion was characterized by cows of the second group, in which this index was on average 4.1 kg/min, which was close to the value of Schwyz cattle of the III group, but on 9.8 % (P<0.05) exceeded indicator of cows of Sumy selection of I (control) group.

In the conducted researches, there was a high and direct functional dependence between the magnitude of the one milk-yield and the index of maximum intensity of milk excretion, which is at the level  $r = +0.63 \pm 0.029$ . In this case, the regression coefficient is 0.21 units.

Thus, Schwyz cows of Austrian breeding are quite easily adapted to the new technological and ecological conditions of the steppe zone of Ukraine, and therefore have a high one milk-yield of 11.7-11.8 kg, and an active form of realization of the reflex of milk yield.

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#### REALIZATION OF MILK PRODUCTIVITY OF HOLSTEIN COWS OF DIFFERENT AGE ON THE INDUSTRIAL COMPLEX OF MILK PRODUCTION

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Among the cows of milk production especially popular in our country the Holstein breed of cows, this was introduced by breeders in the 19th century in the USA. Herds of Holstein cattle have a high genetic potential of dairy production, and many animals have a record productivity [1, p. 2]. The highest average daily milk-yield in most cows is, as a rule, in the second month of lactation, and as lactation increase, they certainly decrease. The longer the period of lactation, the less specific gravity in it in the first months with a high average daily productivity of the animal [2, p. 15]. Increasing the duration of the service-period naturally leads to an increase of days of the dairy and the total lactation fee. At the same time, increased the milk-yield during the 305 days of lactation, and with the prolongation of the service-period increases the time a reduced productivity in cows as a result of pregnancy [3, p. 3]. In modern conditions of industrial production of milk, the service-period at 340-360 days is considered normal.

In the conducted researches, the average duration of one productive period in Holstein cows from the first to the sixth lactation was at the level of 342.1-351.5 days. Taking into account the dry off time before the next calving, the duration of the period between calving of these experimental animals slightly exceeded the norm and amounted to an average of 400.2-410.5 days. Considering the level of milk productivity of Holstein animals for the entire period of lactation, it should be noted that it increase from the first-heifers of the first lactation, acquired the maximum value in cows on the third and remained practically identical in animals during the fourth, fifth and sixth lactation. Thus, 7747.7 kg of physical or 7532.6 kg of 4 % milk was obtained from the first-heifers, which inferior to the indicator of cows in the second lactation, in which the milk-yield was an average of 8597.8 kg and 8245.8 kg of 4% milk, respectively, at 10.9 % (P<0.001) and 9.5 % (P<0.001).

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The productivity of Holstein cows in the third lactation was on average 9422.2 kg of physical or 9220.0 kg of 4 % milk, which was higher than the animals of the second lactation, respectively, by 8.8 % (P<0.001) and 10.6 % (P<0.001), and in comparison with the first-heifers, such an excess was already 17,8 % (P<0.001) and 18,3 % (P<0.001).

High and almost identical level of milk production was observed in cows with the fourth and fifth lactation in which the physical milk-yield was 9694.3 and 9665.4 kg, or 9551.3 and 9548.6 kg of 4 %, which was higher, the indicator of productive animals of the third lactation, respectively, by 2.8 and 2.5 %.

The productivity of Holstein cows in the sixth lactation was on average 9499.3 kg of physical or 9276.0 kg of 4 % milk, which was higher than the index of first-heifers respectively by 18.4 % (P<0.001) and 18.8 % (P<0.001).

The researches have established that in the normal duration of lactation, there is practically no correlation between the livestock and the live weight of Holstein cows. Moreover, in first-heifers and cows of the third lactation, this dependence was r=0.155 and 0.033 respectively, then in the cows of the second to sixth lactation, this dependence was generally negative – r=0.160-0.280.

Having a high genetic potential of milk production, Holstein cows were still characterized by uneven levels of physiological activity, in recount to 305 days of lactation. So, if the cows in the fourth, fifth and sixth lactations for one day accounted for 29.0-29.7 kg of secreted physical or 28.3-29.2 kg of 4 % milk, then the animals of the third lactation the figures were 28.9 and 28.3 kg, which inferior to the value of cows in the fourth lactation respectively by 2.77 and 3.18 %.

Insufficient level of activity during this period was in the second lactation of cows, which was 26.4 kg of physical or 25.4 kg of 4 % milk per day. These indices were inferior to the values of the cows fourth lactation, respectively, by 12.5 % (P<0.001) and 14.9 % (P<0.001). The lowest physiological activity of the organism was in the first-heifers, which for one day secreted only 23.6 kg of physical or 22.9 4 % milk, which was lower than the indicators of third lactation cows, respectively, 22.5 % (P<0.001) and 23.6 % (P<0.001), and by 25.9 % (P<0.001) and 27.5 % (P<0.001) compared to the values of the fourth lactation cows.

Experimental Holstein cows of all ages are characterized by high rates of milkyield. Thus, the cows in the third lactation had this coefficient at the level of 15.1 kg of milk per unit of live weight. In the fourth lactation, this coefficient was at 15.5 kg, which exceeded the value of animals of the third lactation by 2.58 %. With the age of lactating cows, dairy coefficient continued to increase and in cows by the fifth lactation was an average of 15.6 kg, which was greater than the value of third lactation cows by 3.21 %. Only in the sixth lactation dairy coefficient of cows slightly decreased to 15.0 kg. At the same time, significantly lower milk-yield was observed in animals in the second lactation, in which it did not exceed 13.9 kg, which is inferior to the value of cows in fifth lactation by 12.23 % (P<0.001). Insufficient dairy coefficient was observed in the first-heifers, in which it did not exceed 12.8 kg, which was lower than the value of animals of the second lactation at 7.91 % (P<0.01), and compared with cows of the third lactation – by 17.97 % (P<0.001). As O. M. Dundukova and others note (2009) in terms of the amount of milk fat and protein obtained from the animal for the entire productive period, can most objectively judge the intensity of the use of cows in the herd [4, p. 75].

Researches have shown that the production of milk fat for the entire lactation period was high and practically the same in animals by the fourth and fifth lactation and amounted to an average of 378.5 kg. Only slightly lower this product was in cows by the third and sixth lactation, which was at the level of 363.4-365.1 kg, which was lower than the animals of the fourth and fifth lactation at 3.59-4.07 %.

At the same time, a significantly lower indicator of milk fat was characterized by the animals in the second lactation, which produced 320.4 kg, which was less than the value of the cows of the sixth lactation at 13.95 % (P<0.001), and animals of the fifth lactation were 18,23 % (P<0.001). A low indicator of milk fat was characterized by the first-heifers, whose 295.6 kg was secreted, which was 8.39 % higher than the second lactation (P<0.01).

According to the indicator of production milk protein, the highest value was observed in cows in the fourth lactation -319.1 kg. At the same time, only slightly lower this indicator was characterized by animals in the fifth lactation -313.7 kg.

The lowest production of milk protein were characterized by first-heifers, who, during the first lactation period, secreted only 255.0 kg, which was lower than the value of the second lactation cows by 10.86 % (P<0.001), and compared with the indicator cows of the sixth lactation – by 25.14 % (P<0.001).

In total, the production of milk fat and protein was the highest in cows in the fourth and fifth lactation and amounted to an average of 697.6 and 692.5 kg. Only a slightly lower indicator was the cows of the third and sixth lactation, in which this value was at the level of 669.8 and 671.4 kg, respectively. Low milk fat and protein production was noted by animals in the second lactation, which produced an average of 6032 kg, which was by 11.04% (P <0.001) less than the third lactation cows. The lowest value of the production of the main components of milk was characterized by the first-heifers, in which it did not exceed 550.5 kg, which was lower than the rate of second lactation cows by 9.57 % (P<0.001), and compared with the indicator of animals of the third lactation – by 21.67 % (P<0.001).

In general, Holstein cows characterized by high adaptive properties, under which the adaptation index was only slightly lower than the neutral value. Thus, in cows of the third to fourth lactation, the adaptation index was on average  $3.1\pm0.19$  units. A lower adaptation index was observed in the first-heifers and cows of the fifth lactation, which averaged  $-3.3\pm0.23$  and  $-3.3\pm0.19$  units. Cows in sixth lactation were characterized by an adaptation index at the level of  $-2.9\pm0.20$  units, which was lower than the value of the first-heifers by 13.8 %.

Thus, the realization of the genetic potential of milk yield of Holstein cows during economic use increases from the first to the fourth lactation, and the fifth and sixth, due to physiological exhaustion, tends to some decrease. In the normal duration of the lactation period and high milk production, there is no functional dependence between the livestock and the live weight of cows, and the norm of reaction to the conditions of exploitation is close to the neutral value.

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#### REALIZATION THE GENETIC POTENTIAL OF MILK PRODUCTIVITY OF HOLSTEIN COWS AT INTENSIVE TECHNOLOGY OF EXPLOITATION

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The reproductive ability to a certain extent characterizes the milk productivity of cows, because the lactation function of cows directly depends on the ability of the animals to reproduce. The duration of lactation is practically determined by the service period, the shorter it is, and the faster the animal is fertilized after calving and shorter the lactation. And, conversely, the longer the period from calving to fertilization, the longer the lactation period [1; 2].

The aim of the research was to establish productive and reproductive qualities of pure-breed cows of the Holstein breed of all ages at normal and long-term lactation function. For research were selected animals of the second and third lactation with potentially high milk productivity. All animals were formed in 4 experimental groups: I group (n=96) – cows of second lactation, service period up to 80 days; II (n=94) group – cows of the third lactation, service period up to 80 days; III group (n=80) – cows of second lactation, service period up to 80 days; IV (n=62) group – cows of the third lactation, service period more than 300 days.

Researches have shown that at industrial technology of exploitation, the level of milk productivity of cows of all groups is high. Thus, in the experimental Holstein cows of I group of the second lactation was received 10749.5 kg of physical or 10684.0 kg of 4 % milk, whereas in the well-adapted animals of II group of the third lactation - 10879.4 kg of physical or 10890.7 kg 4 % milk. That is, within the

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305-day lactation, the level of milk productivity of Holstein cows in the second and third lactation is high and practically equal, indicating high genetic potential and optimum level and quality of feeding.

Despite the long lactation function, the experimental animals of III and IV groups according to the productive qualities, brought to the general denominator of comparison, almost exactly corresponded to indicators with normal duration of lactation function. Thus, the level of milk productivity of Holstein cows of III group for the 305-day period of the second lactation is 11260.4 kg of physical milk, or 4% milk – 11097.0 kg. Practically the same level of milk productivity is noted in IV group, in which the milk-yield is an average of 11254.1 kg of physical, or 10930.4 kg of 4 % milk.

Nevertheless, during the entire lactation period, experimental groups of Holstein cows, with a long lactation period, were characterized by a much higher level of milk-yield. Thus, animals of the III group during the entire second lactation period produced 17213.0 kg of physical or 16986.0 kg of 4 % milk. These indicators, of the level milk productivity, higher values of the same animals of the second lactation of I group, respectively, at 36.9 and 36.5 % at a high probability difference of P<0.001.

Cows of IV group of the third lactation period were characterized by a close synthetic activity of milk of the udder of animals of III group, therefore secreted 17382.7 kg of physical or 16903.5 kg of 4 % milk. This level of milk productivity exceeds the rate of the same cows of the second group of third lactation, but with a normal productive period, respectively, by 36.4 and 34.6 % (P<0.001).

It is quite natural that, with the high level of milk productivity, Holstein cows produce a large amount of milk fat and protein. Thus, from animals of the III group during the whole lactation period 440.4 kg of milk fat and 361.7 kg of milk protein were obtained. In experimental cows of IV group, these products are respectively 428.6 and 356.5 kg.

The high level of milk productivity was ensured by high-energy feeds, and high metabolic processes in the body of animals. That is, the violation of the energy imbalance in the body, even during prolonged lactation animals was not observed. The high and balanced level of metabolic processes indicated the optimal ratio of milk fat to milk protein products. In experimental Holstein cows, this ratio was at the optimal level, since it is an average of 1.20-1.22 units.

Scientists think that in realizing the genetic potential of milk productivity of cows should also take into account the intensity of reproduction [3-6]. The importance of this issue is substantiated by the fact that in cows immediately after calving, the trophic function of the gland of the internal secretion of the pituitary gland is mainly aimed at increasing the synthesis and secretion of milk in the udder, rather than restoring the cyclic activity of the ovaries. However, despite the hard conditions of the industrial complex and the minimum possibilities for recovery, some highly efficient animals are successfully adapting and displaying high rates of reproductive function. So, in Holstein cows of I group, the insemination index does not exceed 1.2 units, and the reproduction ability is at the level of one. That's why the period between the calving of this research group of cows is almost consistent the duration

of the year and is on average 357.8 days. In the Holstein cows of the II group, the index of insemination does not exceed 1.4 units, therefore the reproduction ability is at the level of one, since the duration of the service period does not exceed 76.2 days, and the period between calving - 361.2 days. Instead, in the experimental animals of the III group, the index of insemination is on average six units, which fully coincided to the same index of cows of IV group.

According to the industrial technology of milk production, low indicates of reproductive function was also in IV group cows. The duration of the service period in these cows is 419 days, which is 5.24 times longer than normal. It is no coincidence that the period between calving of these Holstein cows is 1.93 times longer than one year, and the reproductive ability does not exceed 0.5 units.

The research has established that if in the experimental cows of groups I and II infertility was completely insignificant and did not exceed 7 and 11.9 days respectively, then the loss of production was also low. So, from each animal of II group in the second lactation period only 0.009 heads of calves were not received. At the same time, from cows of II group losses were only 0.02 heads of calves. Minor infertility indices of these experimental groups determined low milk production losses. Thus, from each Holstein cows of II group was lost 344.4 kg of milk in the third lactation period, and from each cows of I group of the second lactation – only 195.2 kg.

High levels of reproductive function and low loss of products were the result of the high adaptive properties of these animals to hard conditions of exploitation. So, in the cows of I group, the index of adaptation is positive and makes an average of 0.5 units. A bit lower than the value of adaptation, but also positive, in animals of the II group, in which it makes an average of 0.2 units.

It is well known that the use of gonadoliberins does not always have a positive effect [7]. In addition, the introduction of a luteinizing hormone previously to the endogenous wave before ovulation may result in follicular cysts in animals. That is why, in some high-yielding animals, the reproductive function remains very low, even in cows with a long time of exploitation in the industrial complex. Thus, in the experimental cows of III group in the second lactation the infertility lasted 297.7 days, and in cows of IV (control) group – 339 days. A long period of infertility has caused substantial loss of products. From cows of the III group were not received 7567.2 kg of milk and one head of calves. Losses of products were still in IV group animals. During the third lactation period, 8202.2 kg of milk and 1.2 head of calves were lost for each cow of this group.

The low reproductive function of Holstein lactation cows of the second and third lactation determined the indicators of their adaptive plastic organism to intensive exploitation technology. In cows of the III group, the adaptation index is negative and makes -12.3 units on average and in the control group of Holstein cows of the third lactation – -14.2 units. The reproductive ability of cows largely determines the economic efficiency of the enterprise. As noted by M. Z. Basovsky and B. P. Zavertyayev (1975), low fertility indices delay the reproduction rate of the herd and, as a consequence, reduce the intensity of selection of animals by main selection criteria [8].

Thus, within the limits of 305-day lactation and milk productivity, listed in 4% milk, the level of milk-yield of Holstein cows in the second and third lactation is an average of 10684.0-10890.7 kg. For lactation duration more than 600 days the total milk-yield is 17213.0-17382.7 kg, but the milk loss is 7567.2-8202.2 kg, and calves - 1.0-1.2 heads per each animal.

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#### METHODS OF IMPROVEMENT OF THE MEAT PRODUCTIVITY OF SHEEP

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One of the most difficult problems to be solved by the agro-industrial complex in Ukraine is the increase in meat production, in particular beef, pork, chicken, lamb, not forgetting about improving its quality and reducing its cost.

At the same time, one of the important indicators of the welfare of the population is the level of consumption of products of animal origin, especially meat. Today, in many countries of the world, including Ukraine, there is a sharp deficiency of animal

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protein in human nutrition. At a daily rate of total protein for humans -100 g, including animal origin 60 g, consumption in Europe is satisfied only by 40-70%.

In Ukraine, the level of consumption of animal protein is 2-3 times lower than in developed countries of the world.

To a large extent, this problem is associated with the inappropriate use of available livestock resources, including sheep breeding, taking into account its meat productivity.

To date, the production of lamb in Ukraine and abroad is carried out at the expense of sheep breeding, different productivity directions. Obviously, in the coming years this trend will continue, as the meat industry in the production structure of the economic activity of the sheep industry of Ukraine is still absent. However, as shown by the experience of the states with highly developed livestock, it is necessary to have in the country intensive breeds of sheep meat production direction, as it is one of the reserves to increase the volumes of production of such dietary products as meat of this species.

The research on improvement of meat qualities of sheep of different breeds was conducted by A.M. Zhyryakov and R.S. Hamitsayev [2, p. 38]. They note that the results of crossbreeding of sheep with fine and coarse wool with rams of meat-and-wool breeds in various natural and climatic zones indicate a rather high efficiency of using rams both in imported and domestic meat-and-wool breeds.

In many countries of the world, the problem of producing sheep meat is solved by various methods:

- receiving lambs of the first generation from crossbreeding of different breeds, using the effect of heterosis;

- intensive feeding of young sheep;

- breed formation - due to the use of the breeding stock and rams of intensive meat breeds with the subsequent attachment of productive features (breed formation).

The increase in meat productivity of breeds breeding in Ukraine and the near abroad was carried out by crossing such breeds of sheep like Lincoln, Romney-Marsh, as well as Texel, Olibs, Charolais.

The level of meat productivity of sheep and meat production is determined by methodological approaches.

The determining factor in the value of meat productivity and tissue growth, which forms the meatiness of carcasses, is the amount of live weight of sheep, which imprints on some indicators of meat productivity. Therefore, a measure of live weight is an important sign of sheep meatiness. Consequently, when crossing between breeds and breeding to increase the meat productivity of sheep it is necessary first of all to increase the live weight of animals [1, p. 25].

Work on the establishment of sheep's livestock with good meat qualities is also held in Ukraine in the Steppe zone. For this purpose used sheep of such breeds are Askanian meat-wool, Olibs, Charolais, Texel, Gisar (Pokhil V.I).

High productivity and tribal value are shown by Ascanian crossbreds when used in the conditions of the South of Ukraine. Local sheep were characterized by better indicators of growth and development, which made it possible to have a larger live weight in the livestock population and higher slaughter quality with good indicators of quality characteristics of meat [5, p. 67].

The results of scientific research and the practice of advanced farms indicate that the main condition for increasing the production of lamb is the good organization of the reproduction of the herd and skillfully developed technology of growing and fattening of the separated lambs. The latter makes it possible to maximize the high growth energy of young animals and switch to the cyclic production of high-quality lamb (Pokhil V.I.).

In general, it should be noted that the most rational way of creating a highly productive livestock of sheep characterized by good meat qualities is to cross the various aboriginal breeds of sheep with rams of intensive meat breeds, breed groups and types, in order to obtain sheep breeds, well adapted to breeding in various natural and economic conditions and that meet the modern requirements of the system of keeping sheep.

At the same time, it is necessary to pay great attention to the cultivation of young stock, as a reserve for the formation of the breeding structure in sheep breeding.

The branch of meat sheep has a number of distinctive features that give it considerable advantages over other:

- sheep are not prone to the conditions of abstinence and feeding. With a minimal cost of cereal concentrates in rations (20-30%) more efficiently uses cheap pastures, juicy, rough feed waste industry;

- from early spring to late autumn, these animals can use pastures on a special grazing system;

- under favorable conditions of feeding allows relatively quick increase of production of high quality mutton and receive benign sheepskin;

- in these animals, the slaughter yield is 50-60%, the yield of higher grades of meat reaches 60%, and the proportion of valuable parts of meat in the carcass is higher than that of other breeds by 3-6%. The ratio of protein to fat in the carcass is 1.5: 1 or 2: 1, which corresponds to the modern international requirements of high-quality beef;

- in these animals, muscular tissue is better developed on those parts of the body that give the most valuable meat – the back, waist and sacrum areas;

- these animals have a significantly higher index of meatiness and accumulate more fat between the muscles and inside them, which determines the "marbling" of meat, so it has a high energy value (8-12%);

- meat sheep produce multicomponent products of high quality (meat, sheepskin, blood, bone, internal organs, etc.), each of them is a raw material for many modern productions. Sheep provides the production of good and environmentally friendly raw materials for the leather industry.

One of the breeds used in crossing to increase and improve the meat qualities of sheep in different natural climatic zones is a gisar breed that has its own distinctive features [3, p. 8].

This breed is breeding in different regions of Ukraine, including the Autonomous Republic of Crimea. In the central zone, which is engaged in the breeding of sheep of this breed, is LLC Terra Rich, Pologovskogo district of the Zaporozhye region.

The Gisar breed of sheep belongs to the group of meat and sebaceous breeds and is one of the largest in the world. The main specialization is the production of meat and sebum. Sheep are characterized by large size, slim build, large live weight, wellmarked meat and fatty forms, well developed, have a strong constitution, strong limbs with well-developed muscles and a strong hoofed horn, which allows you to use high pastures and make long walks in the mountains. They are able to maintain their fatness for a long time under the extreme conditions of winter maintenance and are distinguished by a high capacity for feeding and fattening.

Sheep of this breed have good indicators of live weight of all sex-age groups. The live weight of females at birth at LLC "Terra Rich" is within 4,5-6 kg, rams - 5,5-6,5 kg; 4-5-month - 40-45 and 48-50 kg, 18-month-olds - 65-70 and 80-90 kg, adults - 80-85 and rams 120-140 kg.

The decisive factor ensuring such a manifestation of signs of precocity is the high milk production of the uterus. We have established during the first two months of lactation, gisar's uterus can produce 90-100 l of milk, the fat content of which varies from 6 to 7%, protein – from 5 to 6.5%.

Average daily gains of live weight of young stock are 280-350 g, with only 6-7 feed units consumed per 1 kg of growth. This fact reflects the very effective ability of animals to transform feed.

The main task of breeding and breeding work with sheep of Gissar breed is the further increase in their number and consolidation in progeny of high productive qualities, as well as the development of appropriate technology of management, which increases the production of meat – lamb and increase the profitability of the industry.

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### SELECTION AND BIOTECHNOLOGY IN MILK COLLECTION IN UKRAINE AND THE WORLD

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The result of the work of breeding livestock breeders in Ukraine is a number of wonderful breeds and types of farm animals that can be lost. The problem is that the methods for assessing their breeding qualities are not consistent with the assessment system adopted in a number of countries that occupy leading positions in the production of certain types of products. In connection with the situation that has developed in recent years, Ukraine has pumped off the shaft of various genetic products: livestock, embryos, sperm production. Instead of using the achievements of world genetics and breeding to improve certain economic and useful features of local livestock, the process of absorption of domestic breeds and types is very high. It is fully related to cattle breeding – one of the main branches of animal husbandry [1, p. 4; 2, p. 126; 7, p. 324].

In order to prove its ability in the markets of livestock products, including its tribal component, it is necessary, as a last resort, to be equal in technical and technological sense, as well as to have a system of assessment that is understandable for specialists from other countries.

In order to increase the genetic level of cattle, a reliable assessment of the breeding and productive qualities of pedigree boars and breeding stock, as well as a high degree of inheritance of the most important economic and useful features that are the purpose of breeding is necessary. In addition, a small interval between generations is required [5, p. 23; 8, p. 434; 9, p. 877]. The current system for assessing the breeding and productive qualities of dairy and dairy cattle in Ukraine is clearly obsolete.

In view of the above, Ukraine needs to develop a model that can explain the impact on the implementation of the genetic potential of the animal's environment and all its individual family ties. Use to estimate the breeding value of bulls-breeders of the BLAP method (best unbiased prognosis of tribal value) allows for objective comparison. Having a high degree of reliability in the transfer of desirable economic benefits from proband to the descendants, the BLAP method is not devoid of significant disadvantages, which in the first place should include the length of the evaluation process and a significant decline in tribal values in the next generation of daughters born from a younger generation of cows.

The process of evaluating and attributing the tribal status to a pedigree selected for pedigree indicators takes a time span of at least five years. All this time, artificial insemination stations are forced to spend a considerable amount of money on the maintenance of animals, and in the case of obtaining negative results of the productivity of daughters compared with their peers from other bulls to eliminate

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them from the herd. Costs are the cost of sperm production and reduce the competitiveness of organizations. During this time, two generations of cows grow, and the probability of transfer of economic benefits to the maternal line from the estimated quality of offspring of the bull-bearer when using it in the next genetic generation is reduced by 20 percent or more. The acceleration of the rate of breeding progress led to the use in livestock genomic selection [3, p. 86; 4, p. 25].

Genomic breeding is a breeding method based on the study of the DNA sequence of animals. It differs significantly from previous attempts to use genetic information to improve breeds. Genomic selection makes it possible to study a large number of DNA markers simultaneously (over 60,000). In the presence of evenly distributed genetic markers in one animal it is possible to estimate its breeding value, based on the relationship between its genotype and the most important economic features: milk yield, milk quality, duration of economic use, reproductive abilities, interior and exterior indicators and other features. This allows the most accurate calculation of the breeding value of the animal through the breeding value index, reducing the time and cost of selecting the best animals for their use in breeding programs. With an accuracy of 75 percent, thanks to the use of the genomic-index method for assessing breeding bulls-breeders, the efficiency of breeding increases at times. Already at the time of birth, his genetic predisposition to the transfer of the desired economic properties to the age, that is, before the beginning of the production use of the bull, becomes known, and after evaluation of the health, growth and development of the bull may be allowed to be widely used in breeding programs. Consequently, genomic selection, as compared with the assessment of the quality of offspring, is as reliable and faster as it provides a multiple reduction of the interval between generations of animals. Genomic selection is much cheaper, there is no need to wait 5 years until the bull is in the evaluation. The obtained results of genomic testing do not change throughout the life of proband [6, p. 5; 10, p. 308].

The method of genotyping is related to the method of estimation of bucks in the quality of offspring. In order to carry out genomic evaluation it is necessary to allocate several stages: the stage of accumulation of information about the genotype of the population which includes the control of cow productivity and evaluation of bulls-progeny by posterity, the identification of markers associated with specific economic characteristics, selection of candidates for genotyping and selection of the best bulls for use in breeding. Today, a robust genomic assessment is available to artificial insemination stations in the countries of North and South America, Europe, Asia, South Africa and Australia. For example, in France alone, 9727 bulls and 17,770 cows and heifers of all breeds were examined for the genotype in 2011, and in 2012, 71114 heads of Holstein breed were subjected to genotyping [6, p. 5; 9, p. 877; 10, p. 309].

It should be noted that the selection of cows was carried out according to pedigree and phenotype. Genotyping markers are an additional reliable way of evaluating decision-making on the use of pedigrees. This is evidenced by world experience. The reliability of the transfer of the economic and useful qualities of bulls estimated at the quality of offspring is: 0.75-0.80, in young genotypic bulls – 0.65-0.7, and when evaluated only by pedigree -0.3. Bulls, selected by genome and then tested on the quality of offspring, show equivalent results of the assessment of the productivity and other economic characteristics of the daughters.

The Food and Agricultural Organization (FAO) Global Information System for Animal Genealogy contains information on 7616 breeds of livestock. Among them, about 20% are classified as those at risk of disappearance. During the last few years, 62 breeds have died out, almost one month per one species breeds. These statistics represent only a partial picture of genetic destruction. For 36% of breeds there is no necessary data on the assessment of their condition. Among a number of the most productive breeds of cattle, the genetic diversity within the breed is undermined by the use for the reproduction of only a few of the most widespread producers. At the same time, the state of livestock is critical for sustainable development of the state, solving global problems of hunger, the development of domestic and new markets, reducing environmental problems, that is, in general, is critical to the global development of all mankind [5, p. 23].

The task of preserving genetic resources and accelerating breeding require a special approach to control their gene pools [8, p. 4359; p. 877]. To this end, different generations of molecular-genetic markers of polymorphism of separate DNA regions have long been used. With their help solved research tasks such as reconstruction of history and genealogy of breeds, their distribution, elucidation of the specifics of their gene pool; development of genetically grounded programs for the sustainable use of local breeds and their conservation; mapping of the main genes of quantitative traits for genomic selection. These markers were also used to solve such application problems, as exception of errors of origin, development of methods for forecasting the quantity and quality of final products, resistance to the conditions of retention and to infectious agents, control of hereditary diseases and pathogen infections.

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#### PRODUCTIVE CAPACITY OF CORN HYBRIDS FOR SILAGE

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Corn is one of the crops with diversified capacity for foodstuffs and feeding stuff production. It is also valuable raw product for processing industry. It has rather high productive potential, thus economic competitiveness comparing with most crops. Development of agriculture in Ukraine depends on sustainable production of food and feed grain. Corn takes leading position in this group according potential production. Technologies of corn growing are becoming more expensive because they include the improving of agrophysical characteristics, water and nutritive ground regimes, phytosanitary condition of sowings under the conditions of constant price increase. That is why a search of new ways of retrenchment by increasing corn yield is of primary importance [1, p. 80].

However we should keep in mind that qualitative corn silage depends primarily on selection of the hybrid. Today there are a lot of selective companies at the market which propose to use hybrids of grain range for silage production. Thus, the hybrids of seed companies of the brands Monsanto, Pioner, Synhenta, Yevralis, KVS, Maisadur, Mais and others are offered. These hybrids are characterized by high plant height that facilitates to the yield of herbage but not always to the balance of nutrients content and high effectiveness of digestion. Moreover, recommended hybrids ensure quite high grain content in ensilage which also can digest not fully, that's why it needs additional plating or reducing to fragments.

There are also specialized corn hybrids for silage. They have low lignin content that facilitates to improving of ensilage digestion in animals stomachs. At the market the company LG proposes such hybrids. Besides today the company "LNZ Grup" proposes hybrids of Laefy type which are characterized by increasing of nutritive part of plant for animals due to the increasing of number of leaves above the spring from 10 to 13 pieces and mainly flour and glasslike starch in grain. The grain content in silage is also of great importance as it contains the most nutritive part of silage for animals. But not always a considerable amount of grain in ensilage indicates its high food value. That is why in this case consistency of grain endosperm makes a difference. Thus, grain with glasslike type of endosperm has

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worse digesting comparing with flour type grain. Separation of this grain is better even by slicing and chewing by animals. Besides in the process of siloing such grain is easier to ferment [2].

Corn silage of the first class should contain 40-50 % of ears in herbage and 25-35 % of dry matter that is achieved by gathering plants in the phase of middle dough stage [3, p. 16; 4, p. 22].

The aim of the researches was optimization of height and development of corn for silage through selecting corn hybrids for the realization of its productivity potential.

The researches were conducted in educational and scientific production centre of Sumy National Agrarian University according to common methods during 2017-2018. Soil of researched field is typical thick loamy middle-humus black soil (chernozem) which is characterized by the following indices: humus content in plowed up layer (according to I.V. Tiuryn) – 4,0 %, reaction of soil solution is almost neutral (pH 6,6), the content of easy-hydrolysed nitrogen (according to I.V. Tiuryn) is 9,0 mg, mobile phosphorus and exchangeable potassium (according to Ph. Chyrikov) is 14 mg and 6,7 mg accordingly for 100 mg of soil.

The object of the researches was the following hybrids: DN Anshlah, Novyi, DN Bereka. The predecessor is winter wheat. The sowing was conducted by widerow method with spacing of 70 cm in optimal terms. General plot area was 50 square meters, record plot was 30 square meters, and research frequency was three-time. Plot placement is systematic. Mineral fertilizers ( $N_{116}P_{24}K_{24}$ ) were applied together with sowing.

During phenological observation in the beginning of growth and development phase corn plants took its occurrence not less than in 10 % of plants, during the whole phase -75 %. The dynamics of increasing ground weight was defined in the main growth and development phases by selecting 10 plants in typical places on the plots in two incompatible replications. The corn yield for silage was counted by the method of completed harvesting and weighing from every plot.

The reaction of corn plants to sort peculiarities was studied by the means of defining its indices of photosynthetic activity. The square of leaf area of sowing was quite changeable and depended on weather conditions during the years of the researches and researched factors.

At the beginning of vegetation period (7-8 leaves) the square of leaf apparatus varied in all plots from 2,4 to 3,0 thousands of square meters per ha on the average during the years of the researches.

In the phase of tasselling the biggest general square of assimilative area of one plant and sowing had the hybrid Novyi (0,56 m<sup>2</sup>; 40,6 thousands m<sup>2</sup> per ha), a little bit less square had the hybrid DN Anshlah (0,53 m<sup>2</sup>; 36,6 thousands m<sup>2</sup> per ha). The variant with hybrid DN Bereka the square was the smallest -0,51 m<sup>2</sup>; 32,8 thousands m<sup>2</sup> per ha.

In the phase of milk-head ripeness the greatest square of assimilative area of one plant and sowing had the hybrid Novyi (0,61 m<sup>2</sup>; 44,2 thousands m<sup>2</sup> per ha), a little bit less square had the hybrid DN Anshlah 100 (0,57 m<sup>2</sup>; 39,3 thousands m<sup>2</sup> per ha).

The variant with hybrid DN Bereka the square was the smallest  $-0,54 \text{ m}^2$ ; 34,8 thousands m<sup>2</sup> per ha.

The weight of one plant in hybrids which were studied during vegetative period of corn was 446-754 g. Thus, the largest weight of corn plant was recorded in the phase of milk-head ripeness. Hybrid Novyi had the greatest plant weight -752 g that is more on 3,9 % (29 g) than in hybrid DN Anshlah and on 6,3 % (47 g) than in hybrid DN Bereka.

The final target of corn growing for silage is to get the most high-quality yield. Yield forming and accumulation of economically valuable part in it is an important result of complex biochemical and physiological processes. The plant shows its all capacities under optimal environmental conditions which depend on certain soil and climatic conditions of a year and sort specific features. The data we got which characterize the value of corn yield for silage completely confirm the thesis above (Fig. 1).

The diagram information shows that yield capacity of hybrids of different ripeness was 45,5-54,5 ton per ha on the average. The maximal yield during the period of researches on the average formed the hybrid Novyi – 54,4 ton per ha. Hybrids DN Anshlah and DN Bereka had this index at the level of 50,0 and 45,5 ton per ha respectively (Figure 1).



Figure 1. Yield capacity of corn for silage depending on sort characteristics (mean value for 2017-2018), ton per ha

The best conditions for formation of corn yield capacity for silage were in the variant with hybrid Novyi. This hybrid had the maximal yield of 54,5 ton per ha, assimilative area of one plant and sowing of 0,61 m<sup>2</sup>; 44,2 thousand of square meters per ha and plant weight of 752 g.

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#### ADAPTABILITY AND CROP CAPACITY OF POTATO VARIETIES IN CLIMATE TERMS IN UKRAINE

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Question concerning stability crop capacity of potato varieties in climate terms in Ukraine still the main problem now. One of the factors to get a high level of productivity of potatoes is to take into account the potential genetic adaptation of potato varieties to various soil-climatic zones of cultivation. The breeding genetic potential of the new varieties is used only for 37–50%. So an important feature of varieties is them adaptivity to critical phases in ontogenesis and environmental particular factors influence [1, p. 203–204].

The latest period breeders are working on breeding of high potential varieties of potato different groups of ripeness depends on their reactions on meteorogical and agrotechnical forces.

The last several decades fluctuations in gidrotermical indexes are found in the same soil-climatic area which make important influence on particular features, qualities and crop capacity of plant as a result.

All those factors require to be more attentive to determine adaptivity potential of potato varieties in specific soil-climatic terms growing [2, p. 10–16].

In Ukraine are a lot of potato varieties different groups of ripeness and economic purpose which can satisfy needs of potato producers. For example, in 2018 year to Register of plant varieties in UA was registered 189 varieties as a UA (42%) and foreign (58%) breeding [3].

To take into account status and problems of potato producing in general different researching was made in order to determine adaptivity criteria which allowed to find

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among exist assortment varieties with high productivity which can be recommended to particular climate area growing.

The research was carried out on areas with soils most widespread for the Polissya and Forest-Steppe zone. General growing technology was applied to seedlings in researching area. The records and observations were carried out in accordance with the Guidelines for research on potatoes, methods of examination of varieties of potato plants and groups of vegetable, melon, spiced and flavored on the suitability for cultivation and use in Ukraine (VCU) etc [4, p. 50–100, 5, p. 5–18].

The main indicator for determining the general species adaptive response of the variety was yield. For this aim was calculated a coefficient of variety adaptivity per yield in year of growing to average yield of the year.

The criterion of adaptability of a variety, which is characterized by high adaptability in the test area, is the coefficient of adaptability (CA) with an index of 1.0 and above.

The annual coefficient of adaptability (CA) for variety demonstrates a ratio of the yield of a particular variety in the year of testing to the average variety yield of the year [6, p. 10-11].

The absolute average coefficient of adaptability (CA) is calculated as the ratio of the variety yield in research years to a long-term average variety yield.

During the years of the test, under the same conditions of cultivation, the varieties responded in different ways to conditions of the soil climatic zones in Polissya and the Forest-steppe of Ukraine in relation to the year of the test.

Analyzing the results, it was established that the coefficient of adaptability 1.0 and above indicates high adaptability of the variety in the soil-climatic conditions of the cultivation zone, despite the changes in weather condition during the growing season.

According to the absolute indices of the coefficient of adaptability (CAA) 1,0 and above, the tested potato varieties are in this order: in Polissya: 'ESMEE' – 1.12, 'CATANIA' – 1.06, 'Constance' – 1.03; in Forest-steppe: 'ESMEE' – 1.16, 'CATANIA' – 1.12, 'Constance' – 1.00. The best yield performed varieties according to the testing results from different years: in Polissya 'CATANIA' – 21,9 t/ha, CA – 1,24; 'Yavir' – 21,2 t/ha, CA – 1,20; 'ESMEE' – 20,3 t/ha, CA – 1,26; in Forest-steppe 'CATANIA' – 24,2 t/ha, CA – 1,13; 'ESMEE' – 22,2 t/ha, CA – 1,34 'Constance' – 21,7 t/ha, CA – 1,01 (table 1).

Such varieties as 'CATANIA' and 'Yavir' in the Polissya, 'CATANIA' and 'Constance' in the Forest-steppe had the most positive reaction to the favorable growing conditions regarding the implementation of its genetic potential, namely the high yield. Such varieties are characterized by specific adaptability. In 2014, under favorable weather conditions, the increase in the yield of these varieties to the annual average variety index in Polissya (17,6 t/ha) was 4,3 t/ha and 3,6 t/ha, in the Forest-steppe (21,4 t/ha) was 2,8 t/ha and 0,3 t/ha respectively. Due to this the specific adaptive ability of the variety manifests itself at a high average variety yield of the year (table 2).

Table 1

|                                   | Yield, t/ha |      |      |                          | Coefficient of adaptability |      |          |                    |
|-----------------------------------|-------------|------|------|--------------------------|-----------------------------|------|----------|--------------------|
| Variety                           | years       |      |      | Average in               | years (CA)                  |      | Absolute |                    |
|                                   | 2014        | 2015 | 2016 | period from 2014 to 2016 | 2014                        | 2015 | 2016     | (CAA)<br>2014-2016 |
| 1                                 | 2           | 3    | 4    | 5                        | 6                           | 7    | 8        | 9                  |
|                                   |             |      |      | Polissya                 |                             |      |          |                    |
| CATANIA                           | 21,9        | 12,0 | 17,8 | 17,2                     | 1,24                        | 0,81 | 1,11     | 1,06               |
| ESMEE                             | 17,1        | 16,8 | 20,3 | 18,1                     | 0,96                        | 1,13 | 1,26     | 1,12               |
| Constance                         | 15,8        | 16,5 | 17,5 | 16,6                     | 0,89                        | 1,11 | 1,09     | 1,03               |
| Ludmilla                          | 11,9        | 17,1 | 11,7 | 13,6                     | 0,67                        | 1,15 | 0,73     | 0,84               |
| Yavir                             | 21,2        | 12,3 | 13,4 | 15,6                     | 1,20                        | 0,82 | 0,83     | 0,95               |
| Average variety yield of the year | 17,6        | 14,9 | 16,1 | -                        | -                           | -    | -        | -                  |
| Variety yield of many years       | -           | -    | -    | 16,2                     | -                           | -    | -        | -                  |
| Forest-steppe                     |             |      |      |                          |                             |      |          |                    |
| CATANIA                           | 24,2        | 20,6 | 17,8 | 20,8                     | 1,13                        | 1,16 | 1,07     | 1,12               |
| ESMEE                             | 21,1        | 20,8 | 22,2 | 21,4                     | 0,98                        | 1,17 | 1,34     | 1,16               |
| Constance                         | 21,7        | 17,8 | 14,8 | 18,1                     | 1,01                        | 1,00 | 0,89     | 1,00               |
| Ludmilla                          | 18,9        | 17,5 | 14,6 | 17,0                     | 0,88                        | 0,98 | 0,89     | 0,92               |
| Yavir                             | 21,0        | 12,4 | 13,5 | 15,6                     | 0,98                        | 0,70 | 0,81     | 0,83               |
| Average variety yield of the year | 21,4        | 17,8 | 16,6 | -                        | -                           | -    | -        | -                  |
| Variety yield of many years       | -           | -    | -    | 18,6                     | -                           | -    | -        | -                  |

# Yield of potato varieties and its coefficient of adaptability during the period of testing in the Polissya and Forest-steppe of Ukraine (2014–2016)

Table 2

# Yield of potato varieties and its deviation from the average variety yield in the Polissya and Forest-steppe of Ukraine (2014–2016)

| Variaty                           |      | Yield, t/ha |      | Deviation from the average<br>variety yield, t/ha |      |      |  |
|-----------------------------------|------|-------------|------|---|------|------|--|
| Variety                           |      | years       |      | years   |      |      |  |
|                                   | 2014 | 2015        | 2016 | 2014  | 2015 | 2016 |  |
| 1                                 | 2    | 3           | 4    | 6   | 7    | 8    |  |
| Polissya                          |      |             |      |   |      |      |  |
| CATANIA                           | 21,9 | 12,0        | 17,8 | 4,3   | -2,9 | 1,7  |  |
| ESMEE                             | 17,1 | 16,8        | 20,3 | -0,5  | 1,9  | 4,2  |  |
| Constance                         | 15,8 | 16,5        | 17,5 | -1,8  | 1,6  | 1,4  |  |
| Ludmilla                          | 11,9 | 17,1        | 11,7 | -5,7  | 2,2  | -4,4 |  |
| Yavir                             | 21,2 | 12,3        | 13,4 | 3,6   | -2,6 | -2,7 |  |
| Average variety yield of the year | 17,6 | 14,9        | 16,1 | -   | -    | -    |  |

| 1                                 | 2             | 3    | 4    | 6    | 7    | 8    |  |  |
|-----------------------------------|---------------|------|------|------|------|------|--|--|
|                                   | Forest-steppe |      |      |      |      |      |  |  |
| CATANIA                           | 24,2          | 20,6 | 17,8 | 2,8  | 2,8  | 1,2  |  |  |
| ESMEE                             | 21,1          | 20,8 | 22,2 | -0,3 | 3,0  | 5,6  |  |  |
| Constance                         | 21,7          | 17,8 | 14,8 | 0,3  | 0,0  | 1,8  |  |  |
| Ludmilla                          | 18,9          | 17,5 | 14,6 | -2,5 | -0,3 | -2,0 |  |  |
| Yavir                             | 21,0          | 12,4 | 13,5 | -0,4 | -5,4 | -3,1 |  |  |
| Average variety yield of the year | 21,4          | 17,8 | 16,6 | -    | -    | -    |  |  |

# Ending of Table 2

Using the coefficient of adaptability 1.0 and above both to the annual and average yield of many years, allows to characterize the productive capacity of the variety to the soil and climatic conditions of the growing area.

The cultivation of potato varieties with high adaptability and permanent yield in respect of a certain soil and climatic zone is a significant factor in increasing the production of potato varieties, especially high-category seed material for varieties rotation and replacement. Such varieties of potatoes in the Polissya are: 'ESMEE', 'CATANIA', 'Constance'; in Forest-steppe: 'ESMEE', 'CATANIA', 'Constance'.

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#### TO THE PROBLEM OF ENVIRONMENTAL EVALUATION **OF THE CONDITIONS FOR THE GROWTH OF AGRICULTURAL CULTURES**

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Formulation of the problem. Reforming land relations in the countryside and especially in the conditions of possible formation of the market of arable land, the problem of preserving their fertility becomes of particular importance [1, p. 34]. Currently, there is no doubt that the criteria for assessing the environmental safety of soils is the creation of conditions for the lack of deficit of the humus balance and the main elements of nutrition. These indicators are interdependent, but formally, not always positive conditions for one indicator predict positive for others. In terms of strategic assessment, in our opinion, the priority should be given to the balance of the main elements of nutrition, the lack of which can be one of the conditions for the lack of deficit of the humus balance.

Analysis of recent research and publications. Currently, there is no doubt that the growing and constant updating of new, more productive varieties and hybrids of agricultural crops requires consideration of the quantitative impact on their productivity norms fertilizer because it substantially differ from previously studied varieties and hybrids value as payback fertilizer use rate as key elements. Such an approach requires a quantitative assessment of their intensity in terms of the use of basic resources, especially mineral nutrition [4, p. 6; 5, p. 7].

The level of productivity established by any method, or the accepted value requires an environmental justification, one of the criteria of which is to ensure the lack of deficit of the balance of the main elements of the supply. There is no doubt that this condition is obligatory, since one of the basic laws of agriculture corresponds to the "law of the return of nutrients to the soil". In this case, there is a need to take into account the problem, the essence of which is that any increase and stimulation of the productivity of the culture is accompanied by an adequate removal of the main elements with the harvest, which is far from always consistent with the norm of the fertilizer. No less important problem in this case should be considered and the balance of mineral fertilizers by the main elements of nutrition [4, p. 30; 5, p. 13].

It should be noted that the existing recommendations on the use of mineral fertilizers take into account the qualitative yield of the alienated products of the main elements of food, but this is not consistent with the reaction of culture to the crop in the established norms [2, p. 21].

In addition, existing scientific developments [3, p. 9; 4, p. 34] on the one hand allow to determine the required rate of mineral fertilizers only when planning, and on

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the other - do not take into account the necessary conditions for lack of deficit of the main elements of nutrition.

The purpose of this study is to establish normative conditions for ensuring the lack of deficit of the main elements at the planning stage and to assess the actual state of the results of the cultivation of some new hybrids of maize under the conditions of the NAIHIA for 2017-2018.

Presenting main material. In assessing the influence of the factor of the variety on the indicators of intensification of cultivation, it is necessary to determine the indicators of its intensity, or yields of this variety. In general, this indicator represents the level of intensity of the variety (RiC) and can be established as the ratio of actual (UV) to the possible, or normative (UN) values of the yield of culture [4, p. 6; 5, p. 11]:

$$RiC = \frac{Y_{\phi}}{Y_{H}} \tag{1}$$

Thus, he shows how many times the actual crop yield of this variety is greater than the yield that can be determined or calculated according to the existing normative data.

In the case when the efficiency of mineral fertilizers is determined by the law of declining yield [3, p. 9; 4, p. 20] the total normative yield of a crop can be expressed in dependence:

$$Y_{H} = aX^{2} + bX + Y_{E}, \mu / a$$
<sup>(2)</sup>

where: *a* and *b* – empirical coefficients [3, p. 17; 4, p. 18];

 $V_{\rm b}$  – productivity, which is formed due to the natural fertility of soils [3, p. 17].

Based on dependencies 1 and 2, we can state that the actual expected yield of a crop can be established as:

$$V_{\phi} = RiC \cdot Y_{H} = RiC(Y_{B} + \Delta Y_{A}) = RiC \cdot Y_{B} + RiC \cdot \Delta Y_{A}, u/a .$$
(3)

The basic elements (X1, cd.r. /c) with the crop yield (Y, c/ha) are defined as:

$$X_1 = Y \cdot \Sigma B_M, u \partial. p. / ca \tag{4}$$

where: – the total content of the main elements of food in the alienated product, cd.r./ha.

Thus, the comparison of the dependence of the reaction of the culture on the fertilizer (formula 3) and the removal of the main elements with the yield (formula 4), allows us to establish a fertilizer norm (equivalent), which will ensure a deficit-free balance of the main elements from the condition [4, p. 34; 5, p. 13]:

$$-a \cdot RiC \cdot X^{2} + (e \cdot RiC - \frac{1}{\sum B_{\mathcal{M}}})X + RiC \cdot Y_{\mathcal{F}} = 0$$
(5)

The work evaluates the results of cultivating some maize hybrids under environmental constraints and compares them with the basic requirements. In our case, on the black earths of the typical regressed medium loamy ones, according to the existing recommendations, we have [3, p. 9; 4, p. 17]:

$$V_{E} = 49,3\mu/a; \Delta V = -0,97X^{2} + 9,27X,\mu/a$$

The results of calculations for establishing the main environmental parameters for some maize hybrids are given in Table. 1

Table 1

| Hybrids FAO | EAO | RiC  | Actua       | l data     | Recommended data |            |
|-------------|-----|------|-------------|------------|------------------|------------|
|             | ГАU |      | HF, kg / ha | UV, c / ha | HE, kg / ha      | Ue, c / ha |
| Star        | 180 | 1,36 | 190         | 86,1       | 242              | 89,2       |
| Stork       | 260 | 1,42 | 190         | 90,1       | 254              | 94,6       |
| Donor       | 310 | 1,53 | 190         | 97,2       | 279              | 103,4      |

#### Parameters of the deficit-free balance of N P K for some maize hybrids and comparison with actual data

The analysis of the data showed that the later the hybrids, the more efficient the use of power resources, the greater the yield. The analysis of experimental data showed that in all cultivar variants a basic nutrient deficiency (NPK) is formed, which, depending on FAO, is 52-89 kg / ha. At the same time, for the equivalent fertilizer norm, the expected increase in yield would be 3.1-3.6 c/ha. There is no doubt that such a statement requires an economic substantiation, but in each case there is a need to choose a priority option.

It has been proved that ensuring the conditions of non -deficiency in the soil of the main elements of nutrition is necessary to take into account the level of intensity of specific varieties or hybrids of agricultural crops.

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# WEED CONTROL TECHNOLOGY ON SOYBEAN CROPS IN THE CONDITOIN OF "AGRIFAS" COMPANY LTD **BILOPILLIA DISTRICT SUMY REGION**

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Soil-climatic conditions of Ukraine mainly contribute to the cultivation of soybeans. The production of soybeans in our country is rather increase which connects with the development of livestock, poultry farmingand significant expansion of nutrition of this crop. In Ukraine, in terms of crop area (more than 2 million hectares), soybeans have entered the first ten most common crops, and with the dynamics of growth surely holds leadership. Soybeans in the beginning of vegetation grow relatively slowly and weeds compete with it for the consumption of moisture, nutrients, and the use of light. This leads to its low competitiveness in comparison with weeds. Weed yields from weeds can range from 30 to 50%. Therefore, the integrated control of weeds is of paramount importance for the successful cultivation of soybeans. In recent years, the problem of protection against weeds has become much worse due to the deterioration of the financial and economic condition of farms, lost to 20% of products, to protect from weeds accounts for one third of the costs of growing crops.

In "Agrifas" Company Bilopillia District Sumy Region we have been researching the effectiveness of herbicides influences on soybeans sowings since 2017 and develop the weed control technology. During this period on soybeans sowings the following types of weed have been revealed: nontrab plain, loboda white, sirens common, mouse blue, millet chicken, thistle pink, pirate creeping. The research was conducted according to the generally accepted methodology. Weed accounting was carried out quantitatively by weight method, since this method is the best for obtaining full information about actual crop infestation. The number of weeds was determined directly by counting their stems on trial sites, selected using a frame with a ratio of width to a length of 1:1. The mass of all above-ground organs of plants was expressed in grams per unit area. It is characterized by three quantities: the mass of living plants (crude mass), their absolute dry mass and the mass of plants in the airdry state. The most accurate estimation of indigestion of crops will be when simultaneously determine both the number and mass of weeds. For this purpose, from a site limited by a frame, we chose weeds and placed them in cellophane bags in order to prevent plants from drying out. In the laboratory, the weeds were spread out by species or groups, counting their number, cut off at the level of the root neck of the roots that was preserved, and weighed.

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Our experiment includes the following scheme: 1. Control (without spraying with herbicides); 2. Spraying Dual Gold 960 EC, k.e., 1,61/ha + Basagran, cf., 2,51/ha (standard); 3. Spraying Gesagard 500 FW, hp, 3.01 / ha + Harmony 75, inc., 8 g / ha (experiment). During the counting on the control in 2017, the following number of weeds was detected: - one-year-old one-day eaters - 23, one-year two-eggplants - 64, perennial grasses-1, perennial two-eggplants - 2. At spraying Dual Gold 960 EC + Bazahran (standard) in 2017 were found the following number of weeds: - annual odnosim'yadolni – 5-year dvosim'yadolni – 8, perennial crops – 1 Long dvosim'yadolni – 2. When spraying Chystets 500 FW 75 + Harmony (research) in 2017, the following number of weeds was detected: - one-year-old single-seeded Aulnay; 6, annual bivalve molluscs - 5, perennial grasses - 1, perennial bivalve trees -2. In 2018, during the counting on the control, the following number of weeds was detected: - one-year mono-foster animals - 34, one-year bivalves - 72, perennial grasses -3, perennial dicotyledons -5, which is much more than in 2017. When spraying Dual Gold 960 EC, BC + Bazagran, dd (standard) in 2018, the following number of weeds was detected: one-year-old one-day eaters - 8, one-year two-heifers; 9, perennial grasses -2, perennial bilaterials -5. When spraying, Gesagard 500 FW, hp + Harmony 75, inc. (experiment) in 2018, the following number of weeds was detected: one-year mono-dog plants - 8, one-year two-eateries - 6, perennial grasses -3, perennial dicotyledons -4. As evidenced by the results of experiments for 2017, the total the number of weeds per 1 m2 in the standard version is -16 pieces, and on the experimental one - 14 units. In 2018, the total number of weeds per 1 m2 in the standard version is -24 pieces, and in the experimental one -21 pieces.

As we can see from the experiment that in 2018 the number of weed on soybeans sowings have increased but it is possible to make conclusion that using herbicides by another way is more effective than in 2017 and 2018.

# **ENGINEERING SCIENCES**

### **MODELLING OF STRESS-STRAIN STATE OF CONCRETE REINFORCEMENT WELDED JOINTS**

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The main stage of the technological process during the construction of buildings and structures of precast or precast monolithic reinforced concrete structures is the placement of reinforcing mesh. Significant amount of effort in the process of production of such reinforcing mesh falls on welding operations. It is due to the high quality of welded joints in comparison with so-called un-welded methods with the use of "Lenton" type muffs or lapped with bonding method [1]. Reinforcement of A-III and A-IV type has been acquired widespread application during the erection of buildings and constructions by mean of monolithic-wireframe technology. Such type of reinforcement is supplied in hot-rolled or heat-strengthened state with the diameter of 8...16 mm made of steel grade A400, Fe360-B, Fe510-B, Fe490 and Fe510-C. Welding process of such reinforcement occurs using manual arc welding, machine welding and bath-arc welding [2].

The complex of experimental investigations of strength characteristics determination of lap and butt joints with strips of reinforcement bars made of electric arc welding has been carried out in the present work. It has been also modelled of stress-strain state of welded joints at the mechanical tensile test.

Welding process of lap joints of C<sub>23</sub>-Pe type was carried out by mean of lengthy side-lap welds with one-sided and double-sided melting (Figure 1, a). Butt joints with double circular-shaped strips of  $C_{21}$ -PH type were carried out in the same way as a previous one with one-sided, staggered and double-sided melting (Figure 1, b).

Mechanical tensile tests of samples of welded joins was carried out according to the ISO 5178:2019. As a result of mechanical tests it has been established that the lap and butt welded joints with one-sided melting do not provide high strength of welded joints. Fatigue limit of such samples do not exceed 192...321 MPa accordingly. Samples fracture constantly was carried out along the welded joint. Low strength of one-sided lap welded joints during the mechanical tensile tests is apparently caused by the combined stress that acquires in consequence of alignment error of load application. Such alignment error of load application leads to the occurrence of bending moment.

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Figure 1. Welded joints of reinforcement realized by mean of manual arc welding: a) lap joints of C<sub>23</sub>-Pe type; b) butt joints of C<sub>21</sub>-PH type

Reinforcement welding using staggered and double-sided welds slightly increased the ultimate strength of welds but do not allow to achieve its uniform strength. Thus, strength factors of lap and butt welded joints of reinforcement in our investigations were variable in the range of 411...578 MPa that is slightly less than the strength of base metal (600 MPa). Samples fracture constantly was carried out along the heat-affected zone and occurred brittle character (Figure 2).



Figure 2. Samples of welded joints of reinforcement after full-scale tensile tests: a) butt welded joints with double strips; b) lap welded joints

Modern ways of mathematic modelling allow to forecast of mechanical behaviour of construction elements including nonlinear behaviour of materials. Load-carrying capability of concrete reinforcement welding joints have been investigated. To achieve this, finite-element model of concrete reinforcements has been designed. Modelling process was carried out using ANSYS Explicit Dynamics system. The results of modelling are demonstrated on the Figure 3.



Figure 3. Modelling of stress-strain state of reinforcement welded joints: a) lap welded joints with double-sided welds; b) lap welded joints with one-sided melting; c) butt welded joints with double strips made of staggered welds

Analysis of modelling of stress-strain state of concrete reinforcements welded joints has been shown the correlation of calculated results with results after full-scale investigations.

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## MONITORING OF ELLIPTICITY AND DEFORMATIONS OF THE CHAIN RANGE OF THE PISTON TUNNEL OF METROPOLITEN

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During the operation of the structures in the soil, the structures are exposed to various negative factors, due to complex hydrogeological conditions, defects of waterproofing, additional loads, errors during design and installation. These factors can affect both individually and jointly. This combination of negative factors often leads to accidents and deformation of the main carriers, therefore, timely care and periodic diagnostics of the condition of bearing structures is required. The monitoring of the status of the tunnel structure allows to prevent the development of defects, to determine the patterns of their manifestation, and if it is necessary to involve the relevant organizations to perform repair work.

In the construction of the tunnels of the Kiev subway in unstable water-soaked soils, as a permanent fixture, cast iron tubes were used. Cast iron has a number of drawbacks, the main of which is their high cost, so they are almost not used at present, but the massive use in the industrial period of development has caused today's engineers to reflect on the processes of deformation, settling and ellipticity of this type of fastening.

The cast iron rim of the tunnel is formed from sequentially mounted rings connected by bolts. Each ring consists of segments (tubing) which in turn are divided into: normal, adjacent, annular.

Most are prone to cracks – adjacent tubes (Figure 1), due to the concentration of stress in the zone of their placement. Depending on the working conditions of the structure and the external factors, deformation can occur in the vault of the tunnel in the form of its settling.

In case of excessive deformations of the tunnel circuit (according to SNiP III-44-77, the allowable deviations of the actual dimensions of the tunnel from the design position should not exceed  $\pm$  50 mm for the overpass tunnels of the subway [1, p. 38]) there is an appearance of ellipticity, which in turn leads to to the violation of the dimensions of the approach of buildings and equipment and to reduce the carrying capacity of more than 25% [2, p. 12]. In connection with the restriction of space, as a result of changes in the geometric position of the vault, a threat to the safe movement of trains is created.

As an example of the development of deformation processes in the structures of the cast-iron structure of the tunnel, a displacement between the art. "Taras Shevchenko" -

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art. "Pochaina" on the Obolon-Teremkiv line of the Kiev Metro, where the cast-iron tubing frame was fitted with the inserted flat reinforced concrete tray unit of the Lentrlubit plant (Figure 2).



Figure 1. Fracture in the annular side of the adjacent tubing



Figure 2. Tunnel frame with inserted flat reinforced concrete tray unit

The tunnels are constructed in water-soaked soils, which include layers of fine and medium-grained sand, soups and loam with peat layers. Depth range from 4 to 8 meters. The inner diameter is 5.1 m.

Fastening of a flat tray on longitudinal bonds with tubing – bolt, ring joints of bolted joints do not have. A wedge-shaped gasket was used as a fixing element instead of a ring tube. The disadvantage of such processing is the difficulty of obtaining a dense connection of the tray unit with a tube on the plane of the longitudinal joint due to the different precision of the manufacture of the docking

elements. The gap formed during the installation of the block is eliminated by the tightening of bolts is impossible, as a result of the vibrodynamic loads of rolling stock there is an expansion of the joint with the deformation of the concrete base of the track and the emergence of the flow with the removal of sand in the tunnel. In addition, such processing eliminates the laying of joints and the necessary tight fastening of elements along the development pathway, which, together with the complicated hydrogeological conditions, vibrodynamic loads from the movement of trains of the subway, and periodic loads from the surface, from the movement of many freight trains, causes the appearance of ellipticity [3, p. 67].

Ellipticity is to expand the horizontal diameter and compression of the vertical (Figure 3).



Figure 3. Elliptic ring

1, 2 - the design and the actual situation; 3, 4 - horizontal and vertical ellipticity

During the survey (at the stage of operation of the tunnel), monitoring of elipticity is carried out by measuring the horizontal diameter and the size of the depressions of the vault using a spacer or laser instrument. Thus, during the period of operation, the maximum settling of the vault of the tunnel arm reached -277 mm with an intensity of up to 10 mm per year. In rings exposed to deformation, there were cracks with the opening up to 2 mm in the annular board with the transition to the back of the tubing.

12 mm thick metal plates, which were installed by fastening bolts to the cluster of the tunnel (Figure 4), were used as reinforcement of the frame. Thus, it was possible to distribute the stresses and to partially reduce the further settling of the top of the tunnel.

The main reasons for the appearance of deformations in such designs can be attributed:

- absence of uniform hardening of the setting, due to design features;
- complicated hydrogeological conditions of the tunnel;
- influence of vibration dynamical load;



Figure 4. Metal plates in the vault of the tunnel

Based on the foregoing, it can be concluded that for the control of the elasticity and strain of the tunnel, a periodic inspection of the technical condition of the structures with fixing of damage and sedimentation measurements is necessary.

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### CONCENTRATIONS OF NITROGEN DIOXIDE, CARBON AND OZONE MONOXIDE IN TIG WELDING OF ALLOYS 1460 AND 1201

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Aluminum alloys are used in welded structures of different purpose. They are characterized by a favourable combination of physical and chemical properties, which makes them attractive for application in the aerospace and rocket engineering industry. In addition to the advantages, when performing welding process, aluminum alloys are characterized by the formation of harmful and hazardous production factors [1, p. 1].

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During welding of the system 1460 (Al-Cu-Li) and the system 1201 (Al-Cu) with non-consumable tungsten electrode, along with the formation of welding aerosols (solid component of welding aerosol, SCWA), harmful welding gases (gaseous component of welding aerosol, GCWA) are evolved to the air of the working zone, belonging to the group of chemical hazardous and harmful production factors [2, p. 1; 3, pp. 33, 34]. The most widespread in the composition of mixture of welding gases is nitrogen dioxide NO<sub>2</sub>, carbon monoxide CO and ozone O<sub>3</sub>.

The aim of the work is to conduct investigations of harmful gases in argon-arc welding of alloys of the system 1460 (Al-Cu-Li) and the system 1201 (Al-Cu) with non-consumable tungsten electrode.

The investigations of the sanitary and hygienic characteristics of harmful gases at the workplace were carried out during TIG welding of high-strength, complexalloyed aluminum alloys1460 and 1201 with a thickness of 3.0 mm. TIG welding was carried out using the welding head ASTV – 2M from the power source MW – 450 of the Austrian company Fronius with the use of non-consumable electrode and the power source IUP-1 made in the USSR. Sampling and investigation of the mentioned gases were carried out in the range of welding modes  $I_w = 140...260$  A.

Sampling was carried out keeping in compliance with DSTU ISO 15011-2:2008 [4, p. 4], and in accordance with the guidelines [5, p. 37], harmful gases were determined. To provide reliability of the obtained results of the investigations, at least 6 samples were taken. The concentration of constituents in a gaseous component of welding aerosols of nitrogen dioxide NO<sub>2</sub> and carbon monoxide was determined using the devices "Aquilon 1-1" and "Aquilon 1-2". The concentration of the component in a GCWA of ozone was determined using the colometric method by sampling, applying the sampler "Typhoon" and the absorbing device with a potassium iodide solution. The condition of the air environment of the workroom was assessed in accordance with the requirements of GOST 12.1.005-88 [6, p. 1].

It was established that welding current strength significantly influences the formation of nitrogen dioxide, increasing its concentration to the values, exceeding its maximum permissible concentration (MPC) =  $2.0 \text{ mg/m}^3$ . The concentration of carbon monoxide is almost unchanged. In the range of welding currents of 140...260 A, the mass concentration of CO is approximately equal to  $1 \text{ mg/m}^3$  and is much lower than its MPC =  $20 \text{ mg/m}^3$ . The results of measurements are given in Tabl. 1 taking into account the error.

Table 1

| or arunning incore anoy 1400 depending on weiging mode |   |               |  |  |  |  |
|--|---|---------------|--|--|--|--|
| Wolding our strongth I                                 | Mass concentration C, mg/m <sup>3</sup> |               |  |  |  |  |
| weiding current strength I, A                          | CO                                      | $NO_2$        |  |  |  |  |
| 140  | $0.4\pm0.7$                             | $1.1 \pm 0.5$ |  |  |  |  |
| 200  | $0.5\pm0.8$                             | $1.3 \pm 0.5$ |  |  |  |  |
| 260  | $0.5\pm0.8$                             | $2.5\pm0.6$   |  |  |  |  |
|  |   |               |  |  |  |  |

# Concentration of CO and NO<sub>2</sub> in the workplace during welding of aluminum-lithium alloy 1460 depending on welding mode

Figure 1 shows that the dependence of the nitrogen dioxide concentration is approximated by the parabola at a high precision, and therefore, the volume of the formed toxic gas grows significantly with an increase in the welding current as  $C \sim I^2$ .



Figure 1. Dependence of mass concentration of nitrogen dioxide at the workplace during argon-arc welding of aluminum-lithium alloy 1460

The concentration of ozone during welding also increases with the rise in welding current strength. At the same time, the concentration of  $O_3$  exceeds its MPC = 0.1 mg/m<sup>3</sup> at all modes of welding: at  $I_w = 140$  A the concentration is 0.13 mg/m<sup>3</sup>, and at  $I_w = 260$  it is A-0.49 mg/m<sup>3</sup>. For the alloy 1460, the ozone concentration exceeds the MPC (Figure 2).



Figure 2. Dependence of ozone concentration on welding mode during welding of alloys 1460  $(1 - I_w = 140 \text{ A}, 2 - I_w = 200 \text{ A}, 3 - I_w = 260 \text{ A})$  and 1201  $(4 - I_w = 140 \text{ A}, 5 - I_w = 260 \text{ A})$  with non-consumable electrode

Thus, it was established that TIG welding of alloys of the system 1460 (Al-Cu-Li) and the system 1201 (Al-Cu) is accompanied by the formation of toxic gases at the workplace: nitrogen dioxide, carbon monoxide and ozone; that in the range of welding currents of 140...260 A, the mass concentration of carbon oxide  $\approx 1 \text{ mg/m}^3$  is much lower than its MPC; that the mass concentration of nitrogen dioxide exceeds

its MPC at intense welding conditions and significantly depends on welding current; that the concentration of ozone during welding of the alloys 1460 and 1201 with nonconsumable electrode increases with the risen welding conditions. At the same time, for the alloy 1460 the ozone concentrations exceed MPC and the level of ozone concentration is 3-4 times higher than that during welding of 1201 at identical modes.

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### INFLUENCE OF CRITICAL PHENOMENA ON THE STRUCTURE OF THE COAL INDUSTRY OF UKRAINE

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Domestic coal industry is and will continue to be the guarantor of the energy security of Ukraine. However, so far it is in a critical condition, especially its public sector, in particular, to provide the economy with deficient marks of anthracite

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energy coal, whose mining enterprises found themselves in uncontrolled territories of the Ukrainian government.

As of January 1, 2019, there were a total of 150 mines in the coal industry of Ukraine, of which 69 were not working, including 49 – due to being located in an uncontrolled area. As a whole, on the territory not controlled by Ukraine there are 85 mines of all forms of ownership, or 57% of their total Ukrainian number. Of the 90 mines formally in the management of the Ministry of Energy and Coal, 55 are located on the territory controlled by the separatists, and 35 are outside the area of combat operations. The share of 35 state mines in all-Ukrainian coal mining is only 14%. This indicates their low efficiency and uncompetitiveness.

In 2014, due to military actions in the Donbas, coal production fell by more than 22% in 2013, and the production of anthracite group fell by one third.

In 2015, the decline in extraction has gained more momentum: coal mining enterprises of Ukraine produced 40 million tons of coal, which is 25 million tons less compared with 2014. At the same time, the decline in production of both energy and coking coal at state enterprises made up even more -62%. In 2016, 41 million tons of coal were extracted. In 2017 and 2018, as a result of blocking the supply of coal from the occupied territories, 35 and 33 million tons respectively were extracted.

According to the results of the coal industry since the beginning of 2019 it became clear that its output from a state of prolonged and deep recession is not happening, especially this applies to the public sector of the industry.

Preserving the negative tendency of falling volumes of extraction of energy coal at domestic coal mines will objectively contribute to the growth of its imports or increase the load on power units of nuclear power plants. Neither the first nor the second adds to the efficiency and safety of the functioning of the domestic fuel and energy complex.

Due to the lack of investment in modernization of the production, the active part of industrial-industrial funds of the industry is working on average by 65%, the depreciation of technological equipment at state enterprises is 80%. In the general park of active coal-mining equipment, the share of mechanized complexes of the new technical level is only one third, and new loading machines and belt conveyors – about 15%. In mines that develop steep slopes, almost 60% of coal mining is carried out by punching hammers.

In the context of the unsatisfactory technical condition of the mine stock and the complex mining and geological conditions of most state coal mining enterprises, the average cost of coal produced by them exceeds the average selling price of tons of coal by almost a third. Therefore, the state is forced to subsidize domestic coal mining. But the lack of such subsidies leads to a large loss of state mines, the inability to finance their own support measures for their own production, as well as to the constant increase of social tension in miner's teams. The latter, first of all, manifests itself in the constant formation of arrears of wages to miners.

The dynamics of the main indicators of the state sector of the coal industry shows that the crisis in the industry only intensifies. Almost 96% of mines have been operating without reconstruction for more than 20 years. Due to the slow
restructuring of the industry, a significant number of small and medium-sized lossy, unpredictable mines are in operation. The wearing out of the active part of industrial funds of the industry becomes considerable scale. Of the total volume of the main stationary equipment, two thirds of it worked out its normative term and need an immediate replacement.

The technical re-equipment of most state mines remains highly problematic. Budget expenditures for the coal industry are decreasing each year. Thus, coal industry enterprises actually received UAH 4.4 billion in 2014, and from 2015 these companies receive just over two billion UAH. annually.

In addition, starting in 2013, funding for technical re-equipment of mines from the state budget is not implemented.

Therefore, it is extremely important to clarify the main directions, principles, timing of reforms and development of the domestic coal industry in the modern conditions, with a clear definition of sources, mechanisms and amounts of funding for program activities.

The war with Russia in the Ukrainian Donbass has considerably worsened the situation in the domestic coal industry. Moreover, in the occupied areas of the Donbas, the coal industry, in fact, was in a catastrophic state.

Now the mines of the occupied Donbas produce 10-20% of pre-war coal volumes. The coal industry in the occupied part of Ukraine may even cease to exist. Problems with the sale of coal products, environmental difficulties, lack of support for miners – a complex of problems for Ukraine's non-controlling mines.

It is clear that, spending at such a rate available resources, destroying them and not providing at least a minimum level of recovery, the occupied territories can only exist for a certain period of time. According to the most optimistic estimates, in five years, the inevitable catastrophe will come.

Given the rather high degree of uncertainty about the future of the occupied territories of Donbass, it should be recognized that this uncertainty is, to a certain extent, extrapolated to the prospects of the development of the entire coal industry in Ukraine.

An analysis of the state and prospects of the development of mining enterprises of the coal industry, which are currently in the temporarily occupied territories of Donetsk and Luhansk regions, made it possible to adjust the forecast of coal production volumes in Ukraine up to 2040 [1, p. 42] upon the return of the occupied territories under the control of the Ukrainian authorities and to develop possible scenarios for the development of the coal industry taking into account the risks and critical phenomena in the structure of the production potential of the coal industry of Ukraine.

The results of the forecasting of coal production in Ukraine as a whole and in the territory controlled by the Ukrainian authorities and the occupied territories are presented separately in Table 1.

In the adjusted forecast of the development of the coal industry for the period up to 2040, account was taken of the restoration of the work of only prospective coal mining enterprises from the temporarily occupied territories of the Donbas upon returning under the control of the Ukrainian authorities.

| J       |                | 1        | L        | L        | /         |        |  |  |  |  |
|---------|----------------|----------|----------|----------|-----------|--------|--|--|--|--|
| Coal    | 2015<br>(fact) | 2020     | 2025     | 2030     | 2035      | 2040   |  |  |  |  |
|         | UKRAINE TOTAL  |          |          |          |           |        |  |  |  |  |
| Energy  | 32593          | 64875    | 74270    | 72205    | 76010     | 70530  |  |  |  |  |
| Coke    | 7145           | 19885    | 24620    | 27525    | 25075     | 16190  |  |  |  |  |
| Total   | 39738          | 84760    | 98890    | 99730    | 101085    | 86720  |  |  |  |  |
| CONTROL | LED BY TH      | E UKRAIN | IAN AUTH | HORITY O | F THE TER | RITORY |  |  |  |  |
| Energy  |                | 34065    | 40755    | 40460    | 44445     | 42480  |  |  |  |  |
| Coke    |                | 10625    | 15035    | 18645    | 17240     | 9020   |  |  |  |  |
| Total   |                | 44690    | 55790    | 59105    | 61685     | 51500  |  |  |  |  |
|         | TEMP           | ORALLY ( | CLOSED T | ERRITORI | ES        |        |  |  |  |  |
| Energy  |                | 30810    | 33515    | 31745    | 31565     | 28050  |  |  |  |  |
| Coke    |                | 9260     | 9585     | 8880     | 7835      | 7170   |  |  |  |  |
| Total   |                | 40070    | 43100    | 40625    | 39400     | 35220  |  |  |  |  |

Projected volumes of coal production for the period up to 2040, thousand tons

Given the likelihood of the return of the occupied territories of the Donbas under the control of the Ukrainian authorities, as well as the lack of funds for the recovery and development of the brown coal industry and the construction of new mines, consideration should be given to the critical scenario for the development of the coal industry, which takes into account the work of mines only under the control of the Ukrainian authorities (Table 2).

Table 2

Table 1

|        | <b>F F</b> |        |       |       |       |       |  |  |  |  |
|--------|--|--------|-------|-------|-------|-------|--|--|--|--|
| Coal   | 2015<br>(fact)   | 2020   | 2025  | 2030  | 2035  | 2040  |  |  |  |  |
| Energy | 32593  | 32830  | 37525 | 36090 | 34470 | 32475 |  |  |  |  |
| Coke   | 7145   | 106255 | 10760 | 10855 | 9450  | 1230  |  |  |  |  |
| Total  | 39738  | 43455  | 48285 | 46945 | 43920 | 33705 |  |  |  |  |

Forecast volumes of coal production in the critical scenario for the period up to 2040, thousand tons

Under this scenario, maximum coal production of 48.3 million tons will be achieved in 2025, of which 37.5 million tons of coal for energy purposes. By 2040 production will gradually decrease to 33.7 million tons, including 32.5 million tons of coal energy purposes.

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# FEATURES OF NORMATIVE AND LEGAL SUPPORT FOR THE RECLAMATION OF DISTURBED LANDS IN UKRAINE

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The disturbed lands are formed mainly as a result of various anthropogenic activity, the bound to disturbe of a soil cover and a geological structure. The most significant consequences at emergence of the disturbed lands are caused by industrial mining. The complex of organizational, legal, technical, financial and other actions related to the implementation of state and local government authorities, land owners and land users rights and responsibilities for the reproduction of disturbed lands is a reclamation [1, p. 37].

The obligation of realization of land reclamation is defined by the Code of Ukraine about a subsoil and the Law of Ukraine "On State Control over the Use and Protection of Land". Subsoil users in Ukraine are obliged to bring the land plots disturbed at exploitation of a subsoil into the state suitable for their further target use in social production [2, p. 79; 3]. Under such circumstances the essential value gets a legislative, normative and methodological support of both industrial development of such lands, and their restoration.

Land reclamation has to be provided in projects of construction of mining objects [2, p. 93]. The purposes and tasks of reclamation and also an order of use of a fertile layer of earth are defined by some provisions and articles of the Land code [4], other laws [5], orders of public authorities of Ukraine [6] and the existing state standards, resolutions and instructions adopted in 1970-80th years in the USSR. It is obvious that separate provisions of the existing normative and methodical documents concerning reclamation accepted up to 1991st year do not conform to requirements of the modern land legislation of Ukraine. In article [7, p. 7] it is shown that state standards on reclamation of lands reflect ideology of the centralized management of planned economy of the country at the prevailing state ownership on the earth. Provisions of these standard documents not consider social, legal, economic, property, administrative-territorial changes and changes of the land relations which happened in Ukraine since the beginning of the 1990th years. Thus, norms, requirements and rules of performance of reclamation, mainly became outdated, do not correspond to conditions of market economy, and therefore need the appropriate adaptation and actualization. At the same time, demand further scientific development of suggestion for improvement of modern normative and legal base of reclamation.

In regions of large-scale open-pit mining of minerals in result irreversible changes natural environments practically full reduction of ecosystems to the previous natural state is impossible. Therefore, it requires the clarification of the regulatory requirement of bring disturbed lands in the process of reclamation to the state and mode of use that preceded the disturbe [8, p. 16].

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The methodical recommendations about designing of reclamation of various types of lands developed in the USSR define structure and amounts of works of technical and biological stages of reclamation. In Ukraine uniform nation-wide methodical recommendations about design of reclamation of all types of the disturbed lands taking into account ecological, economic and social conditions are not developed. At the same time modern ecological the legislation [9] provides, in particulars, need of the thorough analysis and assessment of the impact on the environment not only the decisions made in the project of reclamation, as well as other alternative options. To general faults of normative provisions of the main existing normative documents concerning reclamation and use of a fertile layer of earth in Ukraine it is possible to allocate the following. The preparatory (organizational) stage of reclamation and also the sequence and composition of its works is not allocated. The directions of reclamation terminologically do not correspond to possible categories of lands according to the Land code [4]. Types of further use of the disturbed lands do not correspond to classification of land grounds of Ukraine accepted for quantitative accounting of lands [10].

It is not regulated, how exactly it is necessary to use the stored fertile layer of earth (for reclamation or improvement of unproductive soil layer). Terms of admissible storage of a fertile layer of earth before its obligatory use are not determined accurately. In forms on quantitative accounting of lands the disturbed lands are not distributed on types of disturbes. In Ukraine there is the general concept of reclamation [11, p. 15]. However the order for choosing a rational type of further use of disturbed lands and the direction of reclamation is not yet regulated by normative. Also existing rules do not provide need of maintaining a databank about stored dumps of a fertile layer of earth, control of their balance, a state and use. Thus, modern conditions demand adjustment and addition of normative and legal support of reclamation of lands in Ukraine for reduction it in compliance with requirements of planning of rational use of the disturbed lands in this connection we propose the following measures:

1. Development of the uniform generalizing classification of the disturbed lands for their account with the full list of possible types and views of the disturbed lands.

2. Updating of normative acts with identification of the disturbed lands on subjects of managing (land owners and land users).

3. Development of the normative act about an order of carrying out reclamation of lands with definition of all participants of process of reclamation and their functions, an order of design of reclamation, order of transfer of the restored lands to land owners.

The analysis of the existing normative documents in the sphere of reclamation of lands in Ukraine revealed a number of shortcomings of the existing normative and legal support of reclamation. The discrepancy of concepts and provisions of the existing normative documents in the sphere of reclamation to requirements of land legislations of Ukraine, to the needs of legal support of land reclamation and planning of their rational use for modern conditions, are established. Therefore entering of the relevant amendments and specifications into normative documents is necessary.

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# SELECTION OF HEAT ACCUMULATING MATERIALS FOR SEASONAL SOLAR HEATING SYSTEMS

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The necessity of heat accumulating in solar heating is associated with nonuniform daily and annual incoming and consumption of solar radiation. During the heating season incoming of solar radiation is minimal but heat consumption is maximal. So there is a good reason to consider the possibility to accumulate heat energy in summer with further using it for heating needs during mid-season and heating season.

Store of heat energy in accumulator could be calculated for several months or throughout the year. Relatively speaking using of interseasonal heat accumulator could improve energy efficiency level of heat supply from solar heating systems, as well as systems that use secondary energy resources and summer waste heat from cogeneration units.

Analysis of literary sources has shown that northlands pay much attention to the issue of seasonal heat accumulating. Most common in the world practice (they are very popular in Switzerland, Sweden, Denmark and Israel) are heat capacitative seasonal accumulators [1, p. 57; 2, p. 83] that used for residential buildings and cottage settlements. There are several constructional decisions of such seasonal accumulators.

In spite of the versatility in structure shapes of solar heat seasonal accumulators, their economic viability is low because of high capital investments. Cost-effective installation of seasonal accumulators requires payback period within the scope of 6...8 years. So today designing of effective seasonal accumulator is the main component of further development in heating from renewable and secondary energy sources.

Heat accumulating system generally includes heat-insulated storage reservoir with heat-accumulating material (accumulates and keeps heat energy) and heat-exchange equipment (supplies/carries away heat from heat-accumulating material by charging/discharging of heat accumulator).

Optimal energy efficiency level of heat accumulating and entire solar heating system depends on:

- capital cost of accumulator including construction cost of reservoir and value of heat-accumulating material (HAM);

- operation temperatures of HAM;

- operating costs of accumulator;

- capital costs and operational characteristics of solar collectors and other alternative sources of heat energy.

So the issue of choosing effective HAM (taking into account cost of HAM, its thermotechnical characteristics and construction cost of reservoir) is very important

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at this time. We can find comparing of different heat-accumulating materials in the proceedings of Backman, Daffi and others [1, p. 102; 2, p. 138]. The analysis of literature sources has shown that when reasoned the choice of HAM, capital cost for building of seasonal accumulator were ignored.

In the process of seasonal accumulator designing must be taking into account the factors that have influence on specific value of heat-accumulation such as: specific heat capacity of HAM, its mass density and value, technologically feasible temperature range, environmental friendliness, resource availability and guaranteed service life [3, p. 241; 4, p. 138].

Analysis of influence mentioned above factors on value of accumulated heat allows propose the factorial criteria of optimization. On the ground of this criteria it's possible to compare different types of heat-accumulating materials:

$$K_o = \frac{\theta}{c \cdot \rho \cdot (t_c - t_d)}, UAH / kJ;$$
(1)

where, c – specific heat capacity of HAM, kJ/kg·°C;  $\rho$  – mass density of HAM, kg/m<sup>3</sup>;  $c \cdot \rho$  – volumetric heat capacity of HAM, kJ/m<sup>3</sup>.°C;  $t_c$  – temperature of heat-accumulator charging (depends on physical characteristics of HAM),°C;  $t_d$  – temperature of heat-accumulator discharging (assume 55°C for heating, 45°C for domestic hot water system and 8°C for using heat pumps); s – specific cost of 1 m<sup>3</sup> of heat-accumulator, determined from the formula:

$$\boldsymbol{s} = \boldsymbol{B}_t / \boldsymbol{V}, \boldsymbol{U}\boldsymbol{A}\boldsymbol{H} / \boldsymbol{m}^3; \tag{2}$$

where,  $B_t$  – total value of heat-accumulator including value of HAM, materials for construction of reservoir and building works, UAH;

V – design volume of heat-accumulator, determined from the formula:

$$V = \frac{Q \cdot 10^6}{c \cdot \rho \cdot (t_c - t_d)}, m^3;$$
(3)

where, Q – amount of heat energy that must be accumulated, GJ.

# Technical and economic principle of the proposed optimization criteria ( $K_o$ ) is evaluation of specific costs for keeping (accumulating) of heat energy

To evaluate the different types of HAMs, let's consider the variant of using solar interseasonal heating for the typical cottage house with total area  $S=250 m^2$  and specific heat losses for heating needs  $E_b = 400 \text{ MJ/m}^2$  per annum. This indicator corresponds to the requirements of existing building codes.

 $E_b = 400 \text{ MJ/m}^2 \text{ per annum} = 111 \text{ kWh/m}^2 \text{ per annum}.$ 

So the required amount of heat for heating needs is following:

 $W = E_b \cdot S = 400 \text{ MJ/m}^2 \cdot 250 \text{ m}^2 = 100\ 000 \text{ MJ}$  per annum = 100 GJ per annum.

Let's make a calculation for heat-accumulator with capacity W=100 GJ that could be installed under the building or near it. In case of under-building installation the walls of heat-accumulator could be used also as building footing. This would positively effect on the overall cost of the building.

Assumed construction of heat-accumulator is following:

- hydraulic concrete with thickness 30 mm;
- water-resistant heavy reinforced concrete with thickness 200 mm;

- external heat insulation: mineral wool for walls of heat-accumulator and glass foam for bottom part of heat-accumulator with thickness 600 mm;

- hydrofuge insulation (rubberoid).

Let's consider most common materials with high volumetric heat capacity (water, granite macadam, cast iron, concrete, mineral oil, goudron, glycerin) and prepare a technoeconomic study of using them as heat-accumulating materials for interseasonal solar heating system.

There are good reasons to use desalinized treated water from reverse osmosis system as heat-carrier. For comparing calculations for simple water and water with parameters P=1.5 atm. and boiling temperature 105°C are shown below. The results of comparing HAMs are presented in Table 1.

Table 1

| HAM                | c,<br>kJ/kg∙°C | ρ,<br>kg/m <sup>3</sup> | c*ρ,<br>kJ/m <sup>3</sup> .°C | t <sub>c</sub> , ℃ | t <sub>d</sub> , °C | <b>V</b> , m <sup>3</sup> | B <sub>t</sub> ,<br>th UAH | K <sub>o</sub> ,<br>UAH/kJ·10 <sup>3</sup> |
|--------------------|----------------|-------------------------|-------------------------------|--------------------|---------------------|---------------------------|----------------------------|--|
| Water              | 4,187          | 975                     | 4082,3                        | 95                 | 55                  | 612                       | 851                        | 8,51                                       |
| Water*             | 4,187          | 925                     | 3873,0                        | 105                | 55                  | 516                       | 733                        | 7,33                                       |
| Cast iron          | 0,482          | 7200                    | 3470,4                        | 140                | 55                  | 339                       | 52749                      | 527,50                                     |
| Concrete           | 1,13           | 2242                    | 2533,5                        | 140                | 55                  | 464                       | 664                        | 6,64                                       |
| Mineral oil        | 1,8            | 900                     | 1620,0                        | 140                | 55                  | 726                       | 18635                      | 186,35                                     |
| Granite<br>macadam | 0,84           | 1600                    | 1344,0                        | 140                | 55                  | 875                       | 776                        | 7,76                                       |
| Glycerin           | 2,43           | 1260                    | 3061,8                        | 140                | 55                  | 384                       | 6593                       | 65,93                                      |
| Goudron            | 2,09           | 1000                    | 2090,0                        | 140                | 55                  | 563                       | 3436                       | 34,36                                      |

**Comparing of heat-accumulating materials** 

\* Water with pressure of 1.5 atm. and the boiling temperature  $105^{\circ}C$ 

The analysis of heat-accumulating materials has shown that granite macadam and concrete are the best suited for utilization of high-temperature heat from renewable energy sources (including solar heating systems) and excess high-temperature heat from cogeneration units and thermal power plants. Most expensive heat-accumulating material is cast iron. So using all potential of its operating temperature range (up to 800°C) is essential. When we use nighttime tariffs for electricity it is possible to heat cast iron accumulator to 500-600°C and decrease the sizes of accumulator in 5-6 times. Water is the best suited for utilization of low-temperature heat (renewable and excess heat with temperature up to 95°C). Expenditures for temperature increase of water are not justified because of complicating of system operation and costs for additional equipment. For heat-carrier with temperature higher 120°C it is wise to use granite macadam and concrete as heat-accumulating material.

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## THE TECHNOLOGY OF RECEIVING AND DRYING OF A FOOD CASEIN

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The problem of a full and rational use of milk exists in the whole world despite the system of economic relations and production volumes. This problem has a significant environmental component. Its essence exists in the traditional technology of a dairy production. With a milk separating and a butter production a secondary product appears, which is skim milk. When producing 1 tone of butter up to 20 tone of skim milk is obtained, however its amount depends on the mass fraction of fat in the final product. And the main product of this skimmed milk is casein [1, p. 60].

Due to its composition and qualities a food casein is used in dairy, meat and confectionery enterprises as a protein filler, which improves the quality of final products.

Today the largest manufacturers of a casein are New Zealand, Australia, Argentina and France. They cover 90 % of the world production and export in this sphere.

According to the fact that there is a lot of casein which does not meet the requirements of ND quality indicators at the market, an urgent need of a quality food casein does exist. And a quality of casein depends on a proper technological process. The quality of a food casein can be improved mainly at all stages of its production [2, p. 21].

One of the main and important factors that influences the quality of a casein is the drying process, therefore the main purpose of this work is to study the effects of this drying process of a food casein in order to receive a high quality product.

To receive a food casein skim milk is turned into a clot with the addition of: acid; bacterial fermentation; serum, which is fermented with bacterial liver; milk-coagulation milk enzymes.

When receiving protein concentrates, namely casein, casein fractions of milk proteins are transferred from skimmed milk into the final product.

Food casein was received with the traditional technological schemes that differ from each other with a type of coagulant and affect the yield of a casein and its qualitative indices.

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When receiving a food casein – **sample 1** – an acidic serum with a titrated acidity of 160  $^{0}$ T was added in the role of a coagulant into skimmed milk at a temperature of 30-35  $^{0}$ C. Previously a serum was sourced with a combination of fermentations FD DVS CHN-19 + FD DVS Flora Danica by the company Christian Hansen. These fermentations contain the mixed cultures Lactococcus lactis ssp. lactis, lactococcus lactis ssp. cremoris, Leuconostoc mesenteroides ssp. cremoris, Lactococcus lactis ssp. diacetylactis.

When receiving a food case in – sample 2 – a combination of ferments FD DVS CHN-19 + FD DVS Flora Danica was added in the role of a coagulant into skimmed milk at a temperature of 30-35 <sup>o</sup>C.

When receiving a food case in – sample 3 – a milk-enzyme ferment CHY-MAX Extra 600 IMCU was added in the role of a coagulant into skimmed milk at a temperature of 30-32 <sup>o</sup>C.

When receiving a food casein – **sample 4** – a laboratory leaven "Symbiter concentrated" was added in the role of a coagulant into skimmed milk at a temperature of 30-35  $^{0}$ C. That was 4 % of a milk volume and composed of Bifidobacterium, Lactobacillus, Propionibacterium, Lactococcus, a number of strains in the probiotic is 14, the concentration of cells is  $10^{12}$ , CFU/dose.

After coagulation a leaven was removed from all samples, casein flakes were washed with pasteurized and cooled water for 3 times per 10 minutes. The next operation was to squeeze the grain to a moisture content of 150-170 % and to a granulate casein. The final operation was a drying process in a hanging ball and in a fixed ball.

The received clots have different structures, which are shown in table 1.

Table 1

| Sample (type of coagulant)   | Consistency of a clot |
|--|-----------------------|
| Sample1 (sour serum)   | flakes in serum       |
| Sample 2 (combination of fermentations<br>FD DVS CHN-19 + FD DVS Flora Danica) | loose and granular    |
| Sample 3 (milk enzymes CHY-MAX Extra 600 IMCU)                                 | gum-like              |
| Sample 4 (leaven "Symbiter")   | loose and granular    |

The characteristics of the received clots

The received consistency of clots is substantiated by the following. The acid coagulation occurs in samples 1, 2 and 4. The 1 sample has a true coagulation that is a result of a rapid pH decrease of skimmed milk from 6,6...6,8 to 4,7...4,6. A precipitate of casein was formed. The mechanism of a true coagulation lays in a reduction of the negative charge which is caused by the carboxyl groups of monoaminodicarboxylic acids (aspartic and glutamine) and by the leftovers of

phosphoric acid with hydrogen ions of serum (lactic acid is formed). A stronger lactic acid cleaves calcium from calcium phosphate, which binds the submicles of casein to the micelle, resulting in breaking down of micelles into submicles, that is a precipitate is finely dispersed [3, p. 33].

The mechanism of a clot's formation is still the same while a casein is allocated in 2-nd and 4-th samples. Only the formation of a precipitate (as in the 1-st sample) does not occur, but a gel is formed, the structure of which is submicceloric.

In the 4-th sample a rennet coagulation has its place. With a milk-enzyme ferment the  $\chi$ -casein, which occupies 50 % of the surface of the casein micelle, breaks down between 105 and 106 aminoacids to para-kappa-casein and glycemacropeptide. This latter one has a high charge and a hydrophilicity. With its detachment the zeta potential (charge) is reduced by almost twice on a surface. As a result of a charge reduction the micelles are combined, because the attraction forces begin to prevail over the repulsion forces. A gel composed of micelles is formed, that is, an emitted casein has a different degree of dispersion [3, p. 55].

In 1, 2, 4 samples the gel is finely dispersed and the particles have a size of 10...15 nm. In the 3d sample a particles' size is up to 400 nm.

A comparative description of the ways of a casein drying is shown in table 2.

Table 2

|   | -            |     | _  |     |            | •   | 0   | 0   |    |     |     |     |
|---|--------------|-----|----|-----|------------|-----|-----|-----|----|-----|-----|-----|
| Sample  | hanging ball |     |    |     | fixed ball |     |     |     |    |     |     |     |
| (type of coagulant)   | 70           | 80  | 90 | 100 | 110        | 120 | 70  | 80  | 90 | 100 | 110 | 120 |
| Sample 1<br>(sour serum)  | 147          | 102 | 64 | 50  | 42         | 34  | 152 | 117 | 72 | 59  | 48  | 41  |
| Samole 2<br>(combination of<br>fermentations FD DVS<br>CHN-19 + FD DVS Flora<br>Danica) | 140          | 90  | 55 | 44  | 35         | 28  | 146 | 98  | 66 | 52  | 43  | 34  |
| Sample 3 (milk enzymes<br>CHY-MAX Extra 600<br>IMCU)                                    | 149          | 111 | 68 | 53  | 44         | 36  | 154 | 120 | 74 | 62  | 51  | 45  |
| Sample 4 (leaven<br>"Symbiter")   | 145          | 96  | 61 | 47  | 39         | 32  | 150 | 114 | 70 | 57  | 46  | 39  |

# A duration of a casein drying process in a hanging ball and in a fixed ball (specific load of material 60 kg/m2, drying rate 5 m/s, wbeg = 170 %, wend = 4 %) at a temperature of a drying agent, °C

As it follows from the table 2 the duration of a casein drying process is lower in a hanging ball if compared with a fixed ball. This is explained by the fact that the drying in a hanging ball is characterized by a continuous chaotic motion and a particles' mixing in a certain volume in height and by a highly developed surface of a

material's touch with a heated air. With such a drying process each particle is evenly washed by a stream of a heated air from all sides. It leads to a steady heating of the material which allows to use an increased temperature of the drying agent (above 100 °C) and an increased material load. This also gives a significant reduction in time, a decrease of a heat impact on the product, a better preservation of the product's qualities if compared with a fixed ball.

A casein that is received with schemes 2 and 4 is being dried faster than a casein that is received with other schemes both in hanging and fixed balls. This is due to the samples 2 and 4 that have a loose and granular structure (finely dispersed composition – the particles have a size of 10...12 nm).

A casein that is received with scheme 4 allows to shorten a fermentation's duration of skimmed milk by a leaven "Symbiter concentrated" if compared with a casein that is received with scheme 2 (from 8-12 hours to 4-6 hours). Also, the duration of pressing and drying of casein grains is reduced due to its high degree of dehydration at a temperature of 40-48 °C for up to 30 minutes.

A casein that is received with scheme 3 (rennet) has a gum-like structure (particles' size up to 400 nm), which makes it more difficult to dry.

According to the studies' results, the drying time of a casein in a hanging ball is reduced by 1.5 times if compared with a fixed ball and takes 30 minutes at a drying temperature of 100 °C to a final moisture content of 10%.

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### **MODELING OF MATERIAL FLOWS OF MANUFACTURING FACILITY**

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Manufacturing facility of any sector and any form of ownership is a complex socio-economic system, that quickly changes performance indicator. The actuality is based on modeling of dynamics of material, financial and other flows of such systems by means of using modern ways of automatization. Most often a change of indicators

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of flows is described by differential and integral equations, but while automatization of reliances of such kind some difficulties appear. Using system dynamics of the method provides for transformation of such equations into linear dependences, considering a change of indicators within quite a small amount of time.

The aim of work is the modeling of material flows in the manufacturing facility with the use of methods of system dynamics.

An object of study is a facility – producer of SIP panels. A focus of the work is material flows of a manufacturing facility.

System dynamics- is modeling and imitation of complex socio-economic systems, that are characterized by generally far-reaching non-linear structures – control loops. The introduced methodology is aimed at computer modeling and is a powerful tool for investigating dynamic processes [1; 2; 3, p. 98-101].

The building of a computer model of material flows will be viewed in the facility of SIP panels- construction material, that has a three-layer structure, consisting of two leaves of hard material and one layer of instant between them.

Baseline data of model is an amount of unit value in the warehouse, the optimum volume of order and an amount of material of each type in the enterprise warehouse.

The building of a mathematical model is based on the following hypothesis: enterprise produces only one type of goods, enterprise works only with large-scale buyers, the enterprise has only one conveyor line.

The main baseline data of a model is a number of goods in the warehouse of an enterprise, that is determined using the following formula:

$$S(t) = S(t - \tau) + \tau \left(\rho(t) - o^{lsb}(t)\right),$$

where  $\rho(t)$  – the pace of goods delivery to a warehouse;

 $o^{lsb}(t)$  – the pace of goods delivery to large-scale buyers;

 $S(t-\tau)$  – an amount of goods in a warehouse in a previous period of time;

 $\tau$  – time interval between solutions of the equations.

The interval between solutions of the equations should be chosen based on the intensity of production. Moreover, this time interval is determined by delays, occurring in a process of enterprise functioning. Delays characterize a process of transformation, whereby on the basis of the pace of incoming flow the pace of flow, in the end, is established. In dynamic systems paces are variable amounts, therefore the pace of flow based on a certain level may not coincide with the pace of incoming flow at different times [3, p. 110].

Delays can occur at different stages of enterprise functioning. For instance, delays connected with the production process: from delivery of materials to an enterprise and dispatching finished goods to a warehouse, there can be a time interval that is equal to a production cycle. Delays of the first-order consist of a level (including the difference between flow paces- incoming and out coming) and a pace of an outgoing flow, based on level and an average duration of delays (intercept), a pace of incoming flow is determined by other model dependences. Delays of higher order are received with the help of inducting the flow through two or more consequent delays of the first

order. Practically delays of the third order are used, that is a balancing act between complexity and accuracy while building a model.

The pace of goods dispatch to large-scale buyers depends on  $Z^{lsb}(t)$  – a number of goods, ordered by large-scale buyers and is determined by the formula:

$$o^{\text{ont}}(t) = \frac{Z^{lsb}(t)}{\tau}.$$

According to assumptions, based on which the model was built, an enterprise vends goods only to large-scale buyers (it is specifically to producers of construction materials), herewith to this model a chain of retail trade can be added, with allowances made for determined value of an average demand on a definite type of goods.

The pace of goods delivery to a warehouse (pace of production  $\rho(t)$ ) is determined by the lowest value among paces value: the pace of production, supplied with materials  $\rho^{mat}(t)$  and planned production p, needed for the fulfillment of orders of large-scale buyers  $\rho^{plan}(t)$ . Moreover, we should take into consideration a delay, connected with production, that is determined by a system of linear equations of the following type:

$$\begin{cases} \Lambda_{1}(t) = \Lambda_{1}(t-\tau) + \tau(\rho_{in}(t) - \rho_{1}(t)); \\ \rho_{1}(t) = \frac{\Lambda_{1}(t)}{1/3 \,\xi^{prod}}; \\ \Lambda_{2}(t) = \Lambda_{2}(t-\tau) + \tau(\rho_{1}(t) - \rho_{2}(t)); \\ \rho_{2}(t) = \frac{\Lambda_{2}(t)}{1/3 \,\xi^{prod}}; \\ \Lambda_{3}(t) = \Lambda_{3}(t-\tau) + \tau(\rho_{2}(t) - \rho(t)); \\ \rho(t) = \frac{\Lambda_{3}(t)}{1/3 \,\xi^{prod}}. \end{cases}$$

where  $\rho_{in}(t)$  – a flow, included in a block of delay;

 $\rho(t)$  – a flow, outcoming from a block of delay (production pace);

 $\Lambda_1(t), \Lambda_2(t), \Lambda_3(t)$ -levels, that determine an amount of production, that is being in a process of production;

 $\rho_1(t), \rho_2(t)$  – flows between levels;

 $\zeta^{prod}$  – an intercept of delay, that is determined by the duration of a production process.

One of the sought indicators is an optimal amount of materials order for production. [4]. In given paperwork an optimal size of the order is used as a criteria of total expenses on storing and duplication of an order, that is depended on the Wilson formula:

$$X = \sqrt{\frac{2YD}{I}},$$

where Y – expenses on the delivery of a material unit;

D – a necessity in a material;

*I* – expenses on storing the unit of material.

In the process of production of SIP panels three types of materials are involved, and for each of them, there is a necessity to calculate value *X*. A necessity in the material is determined by an amount of material in a warehouse and an amount that is needed for fulfilling orders of wholesale customers. Expenses on delivery and storage of the unit of each kind are thought to be known.

This model has gained the program realization by means of electronic tables. Results of a computer experiment with the model are given in Figure 1.



Figure 1. Results of calculating

Fluctuation in graph 1 is based on the irregularity of customers orders. Value of zero of a number of finished goods in a warehouse witness of the absence of output for fulfilling orders due to the availability of delays, between receiving of orders and fulfilling them.

The developed model and its implementation give a chance to analyze material flows in a manufacturing facility and enhance the effectiveness of managing it.

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## DEVELOPMENT OF MODELS OF SPATIAL ANALYSIS OF STATUS OF INTERACTIVE PROCESSES OF COMPLEX SYSTEMS

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Given that objects of special purpose function in a priori uncertainty, characterized by a fuzzy space of states, which requires new intellectual approaches to increase the reliability of the decisions that are adopted, characterized by functional and territorial distribution, a complex hierarchy of interacting processes [1]. It is necessary to predict certain requirements to the mathematical apparatus, methods of objectoriented modeling and analysis of interacting processes of a complex system.

Existing approaches to analyzing, modeling and constructing complex data management and processing systems under these conditions are ineffective because of their functional limitations. It should be noted that the promising apparatus for constructing complex systems is the use of fuzzy logic by Lotfi Zade, and for the analysis and modeling of interacting processes of complex systems. It is expedient to use the petri net system (PN) [1] and its extensions [2].

Given the significant limitations and assumptions, as well as the drawbacks of known models, new solutions and approaches to the further development of ideas for the construction of mathematical models are proposed [2]. Classes of fuzzy network models (FNM) are considered which integrate the advantages of models based on PN and neuro-fuzzy networks (NFN).

Mathematical interpretation of FNM is given as:

$$\widetilde{S}(f) = <\widetilde{P}, \widetilde{T}, \widetilde{F}(f), \widetilde{M}(f)_0, L>,$$
(1)

where  $\tilde{P} = \{ \tilde{p}_j : \mu_{\tilde{p}_i}(k) \}$  – the finite set of fuzzy positions  $\tilde{p}_j$ ;

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 $\mu_{\widetilde{P}_j}(k)$  – the function of belonging to the *j*-th fuzzy set position  $\widetilde{P}$ ;

k – some variable that defines the function argument

$$\mu_{\widetilde{p}_{j}}(k), \quad j = \overline{1, m}, \quad \widetilde{P} \neq \emptyset, \quad \left|\widetilde{P}\right| = m;$$

 $\widetilde{T} = \{ \widetilde{t}_i : \mu_{\widetilde{t}_i}(k) \}$  – the finite set of fuzzy transitions  $\widetilde{t}_i$ ,  $i = \overline{1, n}$ ,  $\widetilde{T} \neq \emptyset$ ,  $|\widetilde{T}| = n$ ;  $\mu_{\widetilde{t}_i}(k)$  – the function of belonging to the *i*-th fuzzy transition;

$$\widetilde{F}(f): (\widetilde{P} \times \widetilde{T}) \cup (\widetilde{T} \times \widetilde{P}) \to \{ x_{ij}(k), y_{ij}(k) \}.$$
(2)

 $\widetilde{F}(f)$  – fuzzy function of incidence  $\widetilde{P}$  and  $\widetilde{T}$ ;

 $x_{ij}(k)$ ,  $y_{ij}(k)$  – Functionalities of incoming and outgoing incidents of some fuzzy positions  $\tilde{p}_i \in \tilde{P}$  and fuzzy transitions  $\tilde{t}_i \in \tilde{T}$ ;

It should be noted that the initial fuzzy space of states of the model (1) is determined by the vector of fuzzy initial marking  $\tilde{M}(f)_0$  of fuzzy model positions  $\tilde{P}$ :

$$\widetilde{M}(f)_0 = \{ \widetilde{M}(\widetilde{p}_i) : z_{\widetilde{p}_i}(k),$$
(3)

 $\widetilde{M}(\widetilde{p}_{i}) \rightarrow [0, 1]$  – fuzzy marking of a fuzzy position  $\widetilde{p}_{j} \in \widetilde{P}$  FNM;

 $z_{\tilde{p}_j}(k)$  – the function of the marking of the *j*-th fuzzy position  $\tilde{p}_j \in \tilde{P}$ ;

L – some predicate, which depends on the set of variables  $\{x_u\}, u \in U$ .

During the study, it was determined that with the increase in the dimension of a complex system in FNM it is necessary to take into account  $\{x_u\}, u \in U$  – a set of additional parameters, characteristics and conditions. It is established that an effective mechanism for reducing the dimension of FNM (1) can be considered colored fuzzy Petri networks (CFPN).

In [2], the concept of CFPN introduced in this way is introduced:

$$\widetilde{S}_{C}(f) = <\widetilde{P}, \widetilde{T}, \widetilde{F}_{C}(f), \widetilde{M}_{0C}(f), \widetilde{M}_{C}(f), L\{x_{u}\}, \widetilde{C}, \widetilde{V}, \widetilde{K}>,$$
(4)

where  $\tilde{P}$  – set of fuzzy positions;

 $\tilde{T}$  – set of fuzzy transitions;

$$\widetilde{F}_{C}(f) = (\widetilde{P} \times \widetilde{T}) \cup (\widetilde{T} \times \widetilde{P}).$$
(5)

 $\widetilde{F}_{C}(f)$  – fuzzy function of network incidents  $\widetilde{S}_{C}(f)$ ;

 $\tilde{M}_C(f)_0$  – vector of initial marking;

 $\tilde{M}_{C}(f)$  – vector of current marking;

 $L\{x_u\}, u \in U$  – a certain predicate, assigned to the set of positions, transitions, functions of incidence in the space of states of fuzzy interacting processes, which determines the additional conditions for the implementation of transitions;

 $\tilde{C}$  – a marker color function that defines the color of each marker  $\tilde{M}(\tilde{p}_j)$  for the network position;

 $\ensuremath{\widetilde{V}}$  – conditions for the operation of transitions depending on the color of the marker;

 $\widetilde{K}$  – number of markers in positions with the account  $\widetilde{C}$  .

Consequently, as follows from (4), the network integrates the network (3) and the advantages of CFPN. In addition, the introduction of the predicate  $L\{x_u\}$ ,  $u \in U$  into model (4), as well as properties  $\tilde{C}$ ,  $\tilde{V}$ ,  $\tilde{K}$  significantly increases the possibilities of the model compared with existing approaches.

Thus, it can be argued that (4) is a significant extension of FNM.

Studies have shown that this approach is effective in practical implementation and reduces the dimensionality of the investigated processes.

Analyze the test case, when the process can be run only if several conditions are fulfilled, and consider the additional capabilities of CFPN (4) as compared to the FNM (1). Let, for certainty, there is a process  $\tilde{d}_r$ , for which it is necessary to fulfill three conditions:  $\tilde{U}_1, \tilde{U}_2, \tilde{U}_3$  from a plurality  $\tilde{U}_1, l \in L$ .

We construct a fragment of the model of interacting processes using fuzzy network models (1). The conditions of the three positions  $p_1$ ,  $p_2$ ,  $p_3$  (Fig. 1a) ensure the implementation of the transition  $t_1$  (the process is carried out  $\tilde{d}_r$ ).

In Figure 1b we will demonstrate this fragment of the model using painted fuzzy Petri nets (4). In Figure 1b, the position  $p_3$  is marked with three-color labels, which is conventionally shown as an additional marking of some conventional positions  $p_1$ ,  $p_2$ .



Figure 1. Fragments of the model:

a – a model fragment constructed using a network (1)

b-a model fragment constructed using a network (4)

The analysis of the above figures showed that the latter version greatly simplifies resource costs, therefore, the efficiency of CFPN will increase with increasing

dimensionality of the model. This is especially true in distributed or hierarchical complex systems, which take into account, apart from objective and subjective factors, meteorological, geographic, physical and chemical. Most of these factors are poorly formalized, so their influence is realized on the basis of fuzzy expert assessments. The development of information technology has brought about significant changes regarding the mapping of the space of states of the interacting processes of complex systems, the integration of traditional approaches and geoinformatics has greatly influenced.

The tool for realizing the provisions of geoinformatics is geographic information systems that allow the use of modern object-oriented information technology and remote sensing technology for describing spatially distributed objects.

For research and modeling of specific spatial objects, models are used: digital spatial model of geospatial data, information model, mathematical model of the image. It should be noted that methods of geographic modeling of a complex geosystem and its components include modeling of structure, dynamics, interconnection, and also functioning of the system in space and time.

The main component of the simulation is the digital model of the terrain, which can be obtained using modern technology. The condition of perception of a digital map is the visualization of a cartographic image encoded on it by displaying its contents on the monitor screen.

In addition, distinguish the following types of information models: information descriptive, information resources, intellectual.

The information descriptive (descriptive) class includes models that are constructed as a description of a process, phenomenon or object, for example, a file, a text document. Information resource model is able to accumulate data for its improvement and optimization (database model). An intellectual model is capable of accumulation of information, self-improvement and implementation of actions based on knowledge-oriented technologies, the use of fuzzy logic, pattern recognition.

Information models are based on mathematical models of the image.

The problem of fuzzy spatial data modeling of complex spatially distributed objects is quite complex and multifaceted. The study suggests the creation of meteorological data based on applications of intellectual approaches that combine object-oriented databases and knowledge for modeling and queries of spatially distributed objects. The analysis of these works showed the importance and promise of research based on models that use fuzzy logic and knowledge-oriented technologies.

In the future, there are perspective studies based on the models of spatial analysis of the states of interacting processes of complex systems using fuzzy logic and knowledge-oriented technologies of geoinformatics.

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# DIRECTIONS OF RE-EQUIPMENT OF PORTS OF UKRAINE DUE TO MODERN CRANES

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In the structure of cargo turnover of sea and river ports of Ukraine there is an need for efficient, reliable, universal lifting machines, namely, portal cranes, which are among the most common means of mechanization, performing up to 70% of the volume of loading and unloading operations.

In the ports of Ukraine, the centralized planned supply of cranes ceased in the early 90s of the last century. Over the past 20 years, the structure of the park of gantry cranes has changed slightly [1, p. 205].

Most of the cranes in the ports are cranes such as "Falcon", "Albatross", "Condor", "Mark" with articulated boom system and boom balancing system.

In the same 90-ies, foreign crane companies (Liebherr, Gottwald) began to produce mobile port cranes with a straight boom without a boom balancing system.

These cranes began to be used in foreign ports, as well as in several ports of Ukraine and Russia.

Currently, there is an active discussion on the prospects for technical re-equipment of ports by cranes [2, p. 18, 3-5], but no convincing decisions and an agreed strategy have yet been worked out.

The solution of this problem is influenced by many factors: the scale of the port, its cargo turnover, the type of cargo, the state of the berths and the crane fleet, the type and deadweight of the vessels, the technology of transshipment processes, economic opportunities.

As a result, it can be noted that the economy and these factors force each port to make its own individual choice [6, p. 161].

Based on the discussion and analysis of the development of the ports, there are four main areas in which the load-lifting fleet is being re-equipped.

1) Modernization of existing gantry cranes. It includes the replacement of relaycontactor control systems for electric drive mechanisms for frequency, the replacement of mechanisms, safety devices and control. The high cost of such systems pays off with high efficiency by reducing the power consumption by up to 30% and increasing the service life of the crane by 10–12 years [7, p. 21].

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2) Updating the fleet of gantry cranes with new traditional cranes with articulated boom system and balancing system.

Ukrainian ports have a peculiarity – most of them are connected with the railway. One of the main tasks of the port cranes was and remains the processing of wagons and gondola cars with bulk cargoes. In this regard, in numerous works [5-6] it is recommended to use articulated boom systems for gantry cranes, where the suspension point moves along a trajectory close to horizontal when the boom reach changes, while the suspension length is minimal, which reduces the free oscillations of the load and improves the performance of the crane.

In addition, due to the movable counterweight at maximum departure, cranes with articulated boom systems have a large carrying capacity. The change of departure in this type of cranes occurs without the inclusion of a lifting mechanism, which reduces the energy consumption of the crane and does not increase the swinging of the load. Articulated boom system does not need complex designs equalizing blocks, tackles or drums, prematurely wearing ropes and requiring adjustment and maintenance.

With all the advantages of the articulated boom system, the replacement and renewal of the fleet of vehicles with this design can become rational in cost and provide the most favorable conditions for the provision of replaceable spare parts. Moreover, Ukraine has the experience and the possibility of producing such cranes, even on a competitive basis, by a number of plants: NKMZ (Kramatorsk), Azovmash (Mariupol), Konecranes Ukraine (Zaporizhia). All these plants already have developed projects and experience in manufacturing new cranes.

These projects include the installation of progressive control systems on the cranes, ensuring a reduction in energy consumption – up to 30%.

The projects of these cranes were developed jointly with foreign firms "Kranbau Eberswalde", "Noell", "Konecranes".

3) Equipping of ports with mobile cranes with direct boom and increased lifting capacity up to 75-100 tons [2, p. 18, 3].

The use of such cranes is effective when processing large-tonnage vessels on deepwater berths of ports. There are only 6-7 such ports in Ukraine, but at least 12-14 sea, as well as river and fish ports need in cranes of medium and low payload.

The experience of using mobile cranes has sea ports in Odessa and Yuzhny, where there are 5 Gottwald cranes, a port in Novorossiysk -5 Gottwald cranes and 2 Liebherr cranes.

In modern construction of portal cranes of foreign manufacturers, control and damping of oscillations is carried out through the use of automated anti-sway systems, for example, the Liebherr Cycoptronic system, which allows controlling the process of cargo movement [8; 9]. However, the practice of operating cranes equipped with an automated anti-sway system has shown that this system is characterized by a long delay in subsequent movement, a slow response of the crane to acceleration. In addition, the recommended electronic systems require automatic control of all operations related to the operation of the crane, which is not always possible for domestic manufacturers due to the high cost of such equipment.

One of the advantages of straight arrows is the absence of boom torsion, but the author [7] notes the presence of deformations of the upper end of the arrow caused by increased stresses from significant bending moments. The disadvantages of the construction of straight arrows include a large rope capacity, which is the cause of numerous accidents.

4) Re-equipment of existing gantry cranes with installation on their portal of a new turntable with mechanisms and direct boom system, similar to the turning part of a mobile crane.

Mobile loading cranes operate on their own diesel generator, which significantly increases the cost and maintenance of these machines. In addition, the movement mechanism has a hydraulic drive, and management of all operations is carried out using a digital controller and a computer.

This version of the refitted crane works in the port of Tuapse and so far does not find distribution.

The above information allows us to conclude that in the foreseeable future, the main type of lifting machine in the ports of Ukraine will remain the traditional type of portal crane with articulated boom system and balancing system.

Production of new cranes, of course, should be carried out on improved projects, taking into account the use of progressive solutions, and on operating cranes, modernization has been carried out with improved operational and technical characteristics.

And in this and in another case, the quality of the crane will largely depend on the quality of the boom system and the balancing system.

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# **ECONOMICS SCIENCES**

## TRENDS OF SUSTAINABLE DEVELOPMENT OF DONETSK REGION

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The main direction of modern development of Ukraine is the transition to the principles of sustainable development. The Strategy of Sustainable Development "Ukraine 2020" [1] defines the purpose, tasks and priority directions of Ukrainian society's development in order to balance the economic, social and environmental factors at both the national and regional levels. Problems of sustainable development of old industrial regions were discussed in the articles [2; 3].

The purpose of the theses is to determine the tendencies of achieving sustainable development in the Donetsk region. The choice of sustainable development in the Donetsk region as a research object is due to the fact that this area is currently in the epicenter of the military conflict. The processes of achieving sustainable development take place under extremely difficult conditions.

It should be noted that an attempt to make an assessment of the regional level of sustainable development was carried out by a number of scientists. Thus, the publication of Omarov S. A. Ogli deserves attention, in which the integral indicator of the sustainable development of the regions of Ukraine is calculated as the sum of the ranks of social, economic and environmental components [4]. According to the 2010-2012, the Donetsk region is classified as an outsider region by the integral indicator of sustainable development. Chernihiv region ranks 27th place in terms of sustainable development; Ternopil region takes the 26th place and Donetsk region is on the 25th place). During the period from 2013 to 2018, the following changes were made in the constituent parts of sustainable development in the Donetsk region.

1. The economic component of sustainable development is presented in table 1.

Donetsk region is an old industrial region characterized by a single-industry deformed structure of industrial production with a significant advantage of heavy industries, an outdated transport and logistics infrastructure; dependence of exportoriented enterprises on the world market conjuncture; high material, energy and capital intensity of production.

During the years of the military conflict, the infrastructure of the Donetsk region suffered numerous losses. In 2018, on the territory of the Donetsk region under the control of the Ukrainian authorities, 7.4 thousand objects for the amount of 4.0 billion UAH remain destroyed and damaged [4] (table 2).

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Table 1

| of sustainable development in Donetsk region ([e])               |       |       |       |       |       |  |  |  |
|--|-------|-------|-------|-------|-------|--|--|--|
| Indicators   | 2013  | 2014  | 2015  | 2016  | 2017  |  |  |  |
| Industrial production indices,<br>in % to the previous year      | 93,6  | 68,5  | 65,4  | 106,4 | 88,0  |  |  |  |
| Sold industrial production<br>(goods, services), billion UAH     | 205,6 | 180,6 | 170,3 | 207,9 | 231,4 |  |  |  |
| Construction production indices,<br>in % to the previous year    | 77,3  | 99,2  | 41,5  | 104,7 | 105,3 |  |  |  |
| Gross regional product per<br>1 person, (in current prices, UAH) | 37830 | 27771 | 26864 | 32318 | -     |  |  |  |
| Volume of accumulated FDI,<br>billion US dollars                 | 3,6   | 3,2   | 2,3   | 1,6   | 1,4   |  |  |  |

# Dynamics of Indicators of the Economic Component of sustainable development in Donetsk region ([5])\*

\* – from 2015 data are given *without* taking into account part of the temporarily occupied territory in the Donetsk region.

Table 2

| initiast detail e destroj ed ds a result of nostinites [0] |                   |           |                  |  |  |  |  |  |  |
|--|-------------------|-----------|------------------|--|--|--|--|--|--|
| Infrastructure objects                                     | Total destroyed   | Including |                  |  |  |  |  |  |  |
|  | (domaged) units   | Destand   | Remain destroyed |  |  |  |  |  |  |
|  | (damaged), units. | Restored  | (damaged)        |  |  |  |  |  |  |
| Residential buildings                                      | 11423             | 4297      | 7126             |  |  |  |  |  |  |
| Life support systems                                       | 352               | 344       | 8                |  |  |  |  |  |  |
| Social infrastructure                                      | 319               | 234       | 85               |  |  |  |  |  |  |
| Road-transport   | 71                | 25        | 36               |  |  |  |  |  |  |
| infrastructure   | /1                | 55        | 50               |  |  |  |  |  |  |
| Industrial objects   | 56                | 37        | 19               |  |  |  |  |  |  |
| Other objects  | 158               | 61        | 97               |  |  |  |  |  |  |
| Total  | 12379             | 5008      | 7371             |  |  |  |  |  |  |

# Infrastructure destroyed as a result of hostilities [6]

2. Sustainable environmental development is the overcoming of the ecological crisis and prevention of environmental risks, ensuring the population's right to safe environment and the environment for health and life (table 3).

The volume of pollutant emissions in the atmosphere has increased to 7.0% in the previous year. The growth of emissions is due to increased capacity and production volumes. In 2016, the region accounted for 14.6% of the waste water disposal (in 2015 it was 15.2%).

3. Sustainable social development is the establishment of equal rights of citizens before the law, social protection and support, ensuring equal opportunities for achievement of material, ecological and social well-being (table 4).

According to the results of 2016, the population's available incomes on the territory under the control of the Ukrainian authorities amounted to 82.7 billion UAH,

which is 6.2% lower than 2015. As per 1 person, the available income amounted to 1620 UAH. The share of expenditures on food products in total costs is 55.9%, the cost of payment for housing and communal services is 15.5%.

Table 3

|  |      |      | 0     |       |       |
|--|------|------|-------|-------|-------|
| Indicators   | 2013 | 2014 | 2015  | 2016  | 2017  |
| Total number of permits for emissions              |      |      |       |       |       |
| of pollutants into the air released                |      |      | 274   | 237   | 389   |
| in the current year                                |      |      |       |       |       |
| Emission of pollutants into the air                | 1110 | 1042 | 0176  | 001 / | 7010  |
| from stationary sources, ths. tons                 | 1448 | 1045 | 917,0 | 981,4 | /04,0 |
| Emissions of pollutants into the air               |      |      | 216   | 27.0  | 20.6  |
| from stationary sources per km <sup>2</sup> , tons |      |      | 54,0  | 57,0  | 29,0  |
| Emissions of pollutants into the air               |      |      | 214.2 | 220.7 | 195.0 |
| from stationary sources per capita, kg             |      |      | 214,5 | 250,7 | 165,9 |
| Drainage of reverse (sewage) waters,               | 1212 | 017  |       | 916   |       |
| mln. cub.m   | 1515 | 917  |       | 640   |       |
| waste production of I-IV classes                   | 52.2 | 177  | 16.0  | 20.2  |       |
| of hazard, million tons                            | 33,5 | 1/,/ | 10,9  | 20,2  |       |

# Dynamics of the main indicators of the ecological component of sustainable development in the Donetsk region ([5])\*

\* – from 2015 data are given without taking into account part of the temporarily occupied territory in the Donetsk region

Table 4

# Dynamics of the main indicators of the social component of sustainable development in the Donetsk region ([7])\*

| Indicators   | 2014 | 2015 | 2016              | 2017              | 2018 |
|--|------|------|-------------------|-------------------|------|
| The number of registered unemployed at<br>the end of the period (according to the<br>State Employment Service), thousand<br>person | 21,4 | 12,1 | 14,1              | 11,8              | 10,8 |
| Average monthly nominal wage of one employee, UAH  | 3858 | 4986 | 5900 <sup>1</sup> | 7580 <sup>1</sup> | 9541 |
| Average monthly available income, UAH  | 2587 | 2186 | 1716              | 1620              | -    |

\* – from 2015 data are given without taking into account part of the temporarily occupied territory in the Donetsk region.

The tasks for the restoration of the Donetsk region are contained in its Development Strategy [5]. This document is in compliance with the State Strategy for Regional Development for the period up to 2020. However, the content of the regional development strategy does not take into account the processes of restoring the tasks of sustainable development of the region. Strategic Indicators for

Implementation of the Ukraine-2020 Sustainable Development Strategy are not used in the development of Donetsk Region development strategies.

Conclusions: 1. The document "Strategy for the development of the Donetsk region for the period up to 2020" needs to be corrected. It is necessary to add an additional section to the Strategy, where the task will be to restore the region based on sustainable development.

2. It is necessary to develop concrete indicators that characterize the processes of restoring the Donetsk region based on sustainable development, individual achievement of the tasks.

3. It is necessary to make adjustments and additions to the Strategy of Sustainable Development "Ukraine2020" taking into account the military conflict in eastern Ukraine. This needs to be supplemented in the list of main goals and objectives – the tasks of "restoring the Donetsk region based on of sustainable development".

4. It is necessary to continue the study of the dynamics of the main indicators of the socio-economic and ecological state of the Donetsk region in order to identify trends and problems of development.

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# SYSTEMATIZATION OF THE TYPES OF FINANCIAL SECURITY OF A TRADE ENTERPRISE

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Determination of the ways to implement the financial security of a trade enterprise determines the identification of its types. At the same time, it becomes important to consider its types but not the content characteristics of the financial security itself. It represents a set of management decisions and actions defined in time and aimed at one or another format of the financial condition of the enterprise. The object of differentiation, in this case, is not the security system itself, but the means of its influence on the target result.

The consideration of financial security as a computational and analytical category directs the research to the determination of the consequences of the functioning of financial security as a management subsystem and is reflected in the financial state of the enterprise. Therefore, the differentiation of signs of the financial condition of the enterprise is a clear decision for the search of forms and methods for ensuring the financial security of the enterprise.

The type of financial security characterizes the degree of manifestation of the most significant signs of safeguarding the enterprise from non-fulfillment of financial obligations and ensuring the financing of target development. Specific differentiation of financial security is expedient to carry out by time points of evaluation and implementation. This allows distinguishing types of financial security that are subject to different criteria of assessment and have their own calculation methods.

In terms of analytical and managerial significance, there is operational, current, and perspective/strategic financial security of the enterprise. At the same time, perspective and strategic financial security are not identical concepts, but the latter, as a rule, is of a promising nature.

Operational and current financial securities differ not only in terms of time but also in terms of analytical purpose and method of quantification.

The analysis of research results shows that for the most part, scientists associate financial security with a certain financial condition of the enterprise. It is not taken into account that the financial condition is only a momentary characteristic. Therefore, achieving the desired financial status of the enterprise for a certain date is not a sign of the strength of its financial position in the current and, more importantly, promising periods.

The more important analytical object is current financial security. Its level to a lesser extent than operational security depends on temporary factors, which actions cannot be predicted. Therefore, the current financial situation that is observed over a certain period is the subject of planning and ongoing control, and the presence of a

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trend in its changes serves as a sign of the need for management decisions and actions in relation to the current financial security system. Current financial security is subordinate and may vary within acceptable limits, which are determined by accepted managerial expediency and subjective perceptions of satisfactory security.

The operational type of current financial security entirely does not solve the problem of full security of the financial activity of the enterprise in the future. The strategic financial security serves to it, the formation of which differs not only in the complexity of management means of security but also in the awareness of its availability.

In the works of both Ukrainian and foreign scholars, the strategic nature of the research object is associated with the perspective of its development. So, in the work of H.V. Blakyta, when determining the essence of the category "business strategy", is considered as "... a system of coordinated directions of its prospective development in the conditions of uncertainty, which are subject to certain long-term goals ..." [1, p. 19].

The point of view of such scientists as V.Ye. Rokhchyn, O.M. Vietrova, and O.V. Polianskyi, concerning the concept of strategic importance deserves attention as well. It characterizes "..... the ability of objects and subjects ... to maintain and (or) strengthen their positions in the global, multinational and local markets for a long time ..." [2, p. 58].

Overall, perspective is a necessary, but not a sufficient sign of strategic importance. In this approach, strategic importance and perspective are the categories that have synonymous content. In addition, the indication of the "duration" of the manifestation of the strategic importance requires substantiation and quantification

Investigating the strategic competitiveness of the enterprise R.A. Fatkhutdinov noted that it is "...a potential ability of an entity to compete in the future in specific markets, which is ensured by a reduction in the manifestation of strategic noncompetitive factors and an increase in the manifestation of the strategic exclusive competitive advantages of an entity (subject) on the basis of a comprehensive strategic diagnosis of ' object or subject, market parameters and competitors, strategy development..." [3, p. 34]. The author, along with the promising nature of strategic importance, pointed to its potential implementation format. This attitude points out precisely that the lack of appropriate potential is a prerequisite for its future development.

The strategic importance of the object is viewed under another angle by A.S. Shpanko, who connected it by "a sign of a market entity that demonstrates the presence of its key development opportunities, acquired through the rapid adaptation of the internal environment of operation to changes in the environment..." [4, p. 48]. Along with the need for the availability of "development opportunities", the author connects the potential nature of the strategic importance of the object with its adaptive ability the changing conditions of the environment. This is a very important refinement since the emergence of the strategic ideology in management is due to the impossibility of predicting changes in external nature.

Potential nature of the strategic importance has another indisputable feature – the potential nature of implementation. This means that the actual evidence of strategic

financial security will be the appropriate financial position of the enterprise from a strategic perspective. The verification of this assumption can only be done after the fact. Therefore, the probable character of strategic financial security is its inherent feature, which has a differentiated level and depends on external and internal organizational conditions of management and management perception of the permissible level of risks.

Strategic financial security should be considered as the managerial potential of financial security of the company, which should be realized in the future. The main features of strategic financial security of an enterprise are the perspective, potential and probable nature of the implementation.

Thus, operational, current and strategic financial security represent different types of security for trade enterprises that have their content, analytical purpose and areas of managerial application.

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## AREAS OF AUDIT OF INVENTORIES OF THE AIRLINE

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Directions of realization of audit of supplies that will allow promoting financial safety of enterprise are in process considered: audit of receipt of supplies, audit of leaving of supplies, taking of inventory of supplies and reflection of supplies in accounting. The proposed directions of the audit will enable the auditor to cover all the main aspects of inventory accounting at the enterprise, to investigate the correctness, timeliness and legality of the inventory records, to timely detect violations, and conduct a qualitative audit of the enterprise.

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The activity of each airline is directly related to the movement of inventories. A prerequisite for ensuring their preservation and correctness of accounting is the timely and correct documentation of transactions in the movement of inventory of the enterprise (receipt, disposal, storage). Therefore, it is important to check the correctness, timeliness and legality of inventory accounting.

The main principles for the formation of inventory accounting are defined in the Regulation (Standard) of accounting 9 "Stocks". Reserves are assets held by an enterprise for resale in the ordinary course of business; they are in the process of production; kept for own use, etc.

As the determining factor for ensuring competitiveness in the market of manufactured products is the condition, formation and use of stocks, which is precisely because of this there is a need for conducting an audit.

Proceeding from the requirements of the current legislation, the purpose of the audit of inventories is the statement by the independent auditor of the adequacy of the financial information on the movement and the balance of production passwords at the enterprise in all material aspects in the regulatory documents regulating the procedure for its preparation and provision to users.

The rational organization of the management of the audit process provides for the observance of certain areas of the audit of production stocks. List of such directions is given in Figure 1.



Figure 1. Areas of audit of inventories of the airline

During the audit of stock inflows, the audit firm first checks the correctness of the formation of their initial value, on which they are credited to the balance sheet of the enterprise. To do this, use the following operations:

- A check is made of the availability and compliance of the primary documents on the receipt of stocks, which are confirmed by the conduct of business transactions;

- Do the stocks correspond to the qualitative and quantitative characteristics indicated in the documents on their receipt;

- Verification of the expense incurred, which is included in the original cost;

- Verification of the absence of expenses in the initial cost of inventories, which according to the law should not be included in it (indirect taxes, which are reimbursed to the customer-the enterprise, etc.);

- Verification of the composition of costs, from which the charged personal value of the inventory is charged (compliance with clause 9 of P(C)BO 9 "Stocks");

- verification of the conformity of the formation of the initial value to the legally defined requirements depending on the sources of the receipt of inventories (in particular, the initial value in exchange for similar assets is equal to the book value of the transferred stock, and not the fair value of the received stocks, as in the exchange of non-specific assets, etc.).

Also, when the stocks are transferred, an audit of the initial accounting is carried out. At this stage, the correctness of the design and availability of primary records of stock records and the correctness of their application is checked. Such documents include: a magazine on cargo registration, a journal of registration of power of attorney, limit-collecting cards, inventory description of inventory, IBC accounting card, TTN, acts of acceptance of inventory and other assets. In addition to the primary documents, it is necessary to check the availability of contracts of full financial responsibility.

In this direction, the correct and timely retrieval and internal movement of stocks are checked. The audit firm establishes the legality of actions that are related to the movement of inventories, and whether there are no significant violations and errors in accounting and reporting.

When auditing internal stock transfer operations, auditors should pay attention to the following significant points: the reasons and the need for relocation; documentary design; fixing responsibility as a result of the transfer of stocks; the correctness of the write-off of the relevant stocks for individual MFOs; the correspondence between primary documents and material reports; mapping of movement in analytical accounting.

The second direction is the audit of stock disposal. At this stage, it is necessary to establish the actual application of the method for assessing the release of inventories (the identified cost of the corresponding unit of inventory, the weighted average cost of production, regulatory costs, sales prices, FIFO) and its compliance with the method, which is specified in the order on the accounting policies of the enterprise. In case of re-issuance of stocks to third parties, it is checked on what basis the vacation was made and under which conditions the sale took place, while the data of the primary documents are checked; the absence of the use of methods that are prohibited

by law or those that have lost their validity (LIFO method); the correctness of determining the average percentage of trade margins, etc.

The auditor establishes observance of serial documentary registration of records and correctness of qualitative indicators for production of stocks.

The next direction is the inventory inventory audit. At this stage, the observance of terms, order, documentary and reflection in the account of the results of inventory inventory checks; orders for inventory, inventory descriptions, acts of controlling valuables, written explanations of material-responsible persons and minutes of meetings of inventory commissions.

During the audit, the audit firm carries out the frequency of inventory (once a year, time 1 time per year, 1 time a year); Whether to carry out unplanned (sudden) inventory separate mice departments, groups, in separate places of storage and in the reporting, etc. at the enterprise. Inventory pricing at an enterprise is carried out in case of a change in the material-responsible person, before drawing up annual financial statements, etc.

Do not carry out obligatory inventory or its carrying out with violations concerning the application of administrative and / or disciplinary liability to employees of the enterprise who commit violations.

The data of the financial statements, compiled without carrying out the inventory, may prove to be unreliable, which, in turn, will result in the calculation of fines and penalties stipulated by the tax code.

It is also necessary to determine how the excess (inventory) of inventories is recorded in inventories and to identify what has led to such a situation and to determine the consequences.

During the audit, inventory reporting in the auditor's responsibility to verify the compliance of the synthetic and analytical accounting data, the main book, the reporting; Verify the probability of data on stock stays in a fixed spot: whether to show inventories at the lowest estimate: either by the initial value or by the purity of the value of inventory sale; Check the accuracy of the information on the stocks that are displayed in the premise to the final vision, which corresponds to the norm P(C)BO 9 "Stocks".

Consequently, the application of the proposed areas of audit will allow the audit firm to conduct a more qualitative audit at the enterprise and will allow guidance to the management to improve and expand the control over the accounting and movement of the enterprise inventory.

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# THE EFFICIENCY OF THE UKRAINIAN INSURANCE MARKET

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One of the driving forces in the development of the national economy is the timely and effective financial support of the real sector of the economy from the side of the insurance market in the case of an insurance event's approach. The analysis of recent researches and publications has shown that the problem of increasing of the efficiency of the insurance market functioning was investigated by many scientists, in particular, Kolomina Y.V., Chornoguzova T.N., Maruzhenko D.S., Oparina V.M., Gamankova O.O., Shirinyan L., Nechiporuk L.V., Kyrylo V. [1], Ermolenko G.G., Javorsjka T.V. [2], and this direction of investigation of the insurance market needs further development. One of the most important problem due to the process of evaluation of the efficiency of any economy branch is the definition of indicators of its efficiency and their consolidation into a system. It should be noted that the efficiency indicators of the national insurance market are fundamentally different from the world's ones due to the peculiarities of the transformational processes in the national economy.

The purpose of the article is to evaluate the effectiveness of the functioning of the national insurance market through the system of consolidated indicators considering to the inversion way of national economy development. At the present stage of development of the national insurance market along with the classic meaning of insurance, which lays in ensuring the economic security of the state and sustained production cycle, new challenges arise. They are facilitated by the emergence of new risks, increasing the frequency of insurance events, saving budget funds at the expense of compensation to the insured persons. According to this situation, an increase of the demand for insurance security, which leads to an intensification of the offer of insurance services on the market, is expected. At the same time, the spread of insurance involves an increase in the number of insurers, a rise of insurance rates, which requires the renovation of the structure and infrastructure of the market, as well as improving the mechanism of state regulation of the insurance market. But the increase of the demand for insurance services doesn't happened, while the burden on the state budget remains too heavy, the level of capitalization of the insurance market decreases, insurers generate profits mainly due to 2-3 types of compulsory insurance, the professional level and the quality of insurance protection remains low.

The paradoxes of low rates of insurance on condition of the unsaturated market, the low demand for insurance services considering high need for insurance protection, the weak offer of insurance services considering the high market capacity, disproportion of market differentiation to types of insurance services,

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ineffective geographical diversification, low insurance culture on condition of low awareness of insured persons are concerned with special circumstances of the national economy develop processes. It should be noted that in order to understand the causes of these paradoxes, we must emphasise the peculiarities of the transformational processes in the national economy: transition from the planned economy to the market one led to the indirect way of the financial and, in particular, of the insurance market development [1, p. 212]. Thus, the national insurance market inversely changed from the state form of ownership of insurance assets to other forms of ownership, based primarily on share capital, from the state monopoly in insurance to a competitive market, from state insurance rates to free pricing [2, p. 117].

The inversion way of the development of insurance in Ukraine is caused mostly by inflationary surges and spontaneous privatization of property, which provoked the accumulation of funds in the insurance sector through redistributive financial processes among market participants and the insurers' avoidance of payments in 1990s. In addition, the mass devastation of industrial objects on condition of the backdrop of lack of investment, increasing value of the raw materials and the lack of innovation, as well as changing of social priorities, that led to replace the classical meaning of insurance, as a mechanism of compensation damages, to the tool of minimizing tax payments and legitimizing doubtful financial flows. On the early stages of the formation of the national insurance market, its structure was characterized by a large number of insurers and low quality of insurance services provided due to low barriers to entry, easy registration procedure, state interest in increasing the size of the insurance market and non strict requirements for the insurers' financial solvency. The current trend is to reduce the number of insurance companies on the national insurance market, the reasons of which are: strengthening the state control of insurers; forcing insurers out of the market due to lack of funds and low profit; withdrawal of a license; activation of merger and acquisition processes, etc.

There are different approaches to the calculation of indicators of concentration and competitiveness of market environments. In the insurance the Herfindahl – Hirschman Index (HHI) is often used: according to the results of 2017 in life insurance segment, it amounted to 1417.52 (in 2016 - 1079.59), it was 305.27 for risky insurance (in 2016 - 280.74); on the whole insurance market it amounted to 272,07 (in 2016 - 245,09) [3]. In the risk segment of the market, competition is high, in the life insurance segment, competition is much weaker and stands at a satisfactory level, when the growth of HHI in the dynamics is indicating an increase in the level of monopolization on the market [3]. This indicates the overburdance of insurers and ineffectiveness of their work in the risk segment of the insurance market [2, p. 121]. An evaluation of the total effectiveness of the insurance market could be conducted on the basis of such consolidated indicators as: the penetration of the insurance market in the GDP, the market density, and the level of gross payments idemnity [3]. The penetration of the insurance market in the GDP (Table 1).

| The main indicators of the insurance market enectiveness in Okrame |       |       |       |       |             |          |       |  |  |
|--|-------|-------|-------|-------|-------------|----------|-------|--|--|
| 2010   | 2011  | 2012  | 2013  | 2014  | 2015        | 2016     | 2017  |  |  |
| The penetration of the insurance market in the GDP, %              |       |       |       |       |             |          |       |  |  |
| 2,13   | 1,73  | 1,52  | 1,96  | 1,69  | 1,53        | 1,71     | 1,79  |  |  |
| The market density, € The r  |       |       |       |       | narket dens | sity, \$ |       |  |  |
| 45,01  | 45,7  | 45,02 | 79,02 | 37,03 | 29,9        | 30,2     | 36,32 |  |  |
| The level of gross payments indemnity, %                           |       |       |       |       |             |          |       |  |  |
| 26,45  | 21,43 | 23,95 | 16,23 | 18,91 | 21,5        | 25,1     | 24,3  |  |  |

| The main indicators of the insurance market effe | ectiveness in | Ukraine |
|--|---------------|---------|
|--|---------------|---------|

Table 1

Source: compiled by author based on [3]

The penetration of the insurance market in the GDP is significantly lower than the critical value, which reflects the required safe level and equals 8% [3]. The density of the national insurance market expresses the cost of insurance per head in monetary terms and is calculated as the ratio of the number of insurers to the population. The index of the density of the insurance market in Ukraine is less than 40 US dollars and significantly less than the critical level, which is 140 US dollars per head [3], mostly due to the low income and low popularity of insurance among the population (Table 1).

Despite the gradual economic growth and the adoptable level of consumer inflation, the volatility of the national currency, the decline in consumer demand and in real income of the population still have prolonged impact on the insurance market and restrain the growth of the insurance efficiency, and as a result inhibit its exit from the inversial spiral. The main objective of the insurance market functioning is the accumulation and redistribution of funds among market players in order to compensate for losses in the case of an insured event. Mathematically, an achievement of this objective can be evaluated as the ratio of the gross insurance payments to the total insurance premiums. In world practice, this figure is about 70%, in the EU 15 - about 80%, in Poland - 60% [3], when in Ukraine it is less than 25%(Table 1), due to the generally low level of development of the national insurance market. Among the main reasons for the low efficiency of the national insurance market insufficient solvency of insurers, low level of insured persons' loyalty, unbalanced number and structure of insurers, uneven geographical diversification of insurers, low level of infrastructure development of the insurance market and uneffective provision of insurance protection should be noted. These reasons are mainly due to the inversion way of the national insurance market's development, in order to reduce the negative impact of which, within the state regulation of the insurance market, it is necessary to strengthen the powers of state supervision bodies over the activities of insurers in the aspect of financial stability, solvency of taken risks, reinsurance, guarantees of the provision of insurance protection; sanify the market from corrupted high-risk insurance companies and those that serve tax
optimization, or at least publicly transferring them to a quasi-insurance category by changing the conditions for their licensing so that policyholders do not refuse the insurance system after the unsuccessful experience of usage such insurers.

Considering the inversion type of development of national insurance, it should be noted that the threat of monopolization of the market and destruction of regional insurers makes a sharp decline in the number of insurers undesirable. The reduction of number of registered insurers occurs against the background of maintaining a high level of concentration on the market, in favor of this is evidenced by the growth of HHI in the dynamics that requires close attention from the side of the Antimonopoly Committee, since only a small number of insurers is conducting a competitive struggle for increasing their market shares. The state regulation bodies should contribute to the timely and complete reimbursement of losses to policyholders through the mechanism of sanctions of insurers on the results of checks of their complaints to the relevant committee at the National Commission for Regulation of Financial Services Markets, which will increase the level of confidence of policyholders in the insurance mechanism.

The state should support the development of the life insurance segment in order to improve the standard of living of policyholders and reduce the burden on the state pension fund, which will allow redirection of the saved state funds for the development of social sphere and industry; to encourage insurers to expand the range of insurance products through the mechanism of tax holidays for new and low-cost insurance services.

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# PROBLEMS OF CERTIFIED PATENTS IMPLEMENTATION ON THE UKRAINIAN MARKET OF INNOVATION

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In the modern world, use innovations in forming the development state strategy takes the top-priority place, which can be explained by the following trends of the world economy:

- the quality of human capital is becoming an essential characteristic of global innovation development, and the mobility of highly skilled personnel ensures knowledge dissemination, contributing to increased competitiveness;

- the role of information technology in the dissemination process of knowledge is becoming more relevant for the further growth of innovation activity;

- globalization forces companies to compete at increasingly levels of technologies and at the same time stimulate the specialization and localization processes of innovations;

- the countries which realized the concept of the national innovation system (NIS) created effective innovative economies within a short historical period of time, which include mechanisms of interaction between the state, business, science and education, and to achieve an increase in the total GDP capacity of science;

- there was a share reduction of the state sector in the stabilization conditions or reduction of "state order" to science from national budgets [1].

Today in Ukraine, only a few elements of the NIS are created and operate, the cycles of the innovation process are weakly linked to each other and are not tied together, so the return on innovation is continue low. There are two main reasons of this:

- Ukraine has very few patents for inventions, only about a quarter of all applications;

– almost 20,000 patents in Ukraine are owned by foreign companies and citizens.

Exploring the Ukrainian innovation market, we can see that 60% of the patents belong to foreigners in the agro-industry, which is considered to be the "locomotive" of the Ukrainian economy. The most active were the US citizens who received in Ukraine 689 patents. EU residents filed 331 patent applications through the European Patent Office. In addition, 297 patents were received in Ukraine by citizens of Germany. Residents of Great Britain have 120 patents, while Japan – 107 [2].

Annually in Ukraine, patents related to the agrarian sector are issued up to 300: mainly in agrochemistry and agricultural engineering. The total number of patents for 11 years has reached 3 240. For comparison, in the Netherlands where the agrarian sector of this country is one of the most innovative in the world, were issued 5 548 patents during this time. In the Netherlands the agricultural crops is

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allocated 20 times less land than in Ukraine – a total of 1.9 million hectares. The industry employs ten times fewer people than in Ukraine. At the same time, the Netherlands exports agricultural products to 91.7 billion euros, and Ukraine – 17.9 billion dollars [2].

The American firm Qualcomm in Ukraine has registered the largest number of patents – 644, which is engaged in development of wireless communication facilities and produces microprocessors. Quarterly Qualcomm spends \$ 5.5 billion for research and development on a global scale. And by the results of 2017, patents brought her a profit of \$ 5.1 billion [2].

Most Ukrainian innovations are borned at universities. The National University of Bioresources and Natural Resources of Ukraine is the patent record holder in Ukraine, which has 579 patents. Another is the National University of Food Technologies which count 405 patents and the National Mining University which has 211 patents [3].

Citizens of Ukraine have issued 5,600 patents since 2007 in foreign jurisdictions in 19 countries. Also the authors and co-authors of over 4,600 inventions spoke in other countries. The most invented with the Ukrainians is Samsung [2].

According to the report "Ukraine in the Global Innovation Dimension Report 2007-2017", presented by the Analytical Group, Ukrainian residents registered patents jointly with United States Technologies Group, an American financial and industrial group that produces aircraft engines, gas turbines, aerospace equipment, climate systems, elevators, etc. [3].

Information technologies (IT) are among the three most important sectors of the economy in Ukraine side by side with the agrarian sector and industry. IT forms in Ukraine takes about 3% of the country's GDP for several years. The main exporters of the Ukrainian IT product are outsourcing companies which are developing software for customers from the US and Europe. According to DOU, 50 of the largest developer companies in Ukraine employ almost 40,000 technical specialists.

Particularly, the five key technologies that Ukrainians are working on are communications (400 patents). The second place is wireless technologies (261 patents), in the third place – data transmission (195 patents). Next are graphic objects (191 patents) and video processing (184 patents) [3].

The conducted researches give an opportunity to characterize the situation, which is formed on the innovative market of Ukraine, as one that promotes innovation and investment development of various industries, their structural reorganization. Ukraine still has a strong scientific and technological potential of scientists, engineers, managers, civil servants, who has developed a large amount of methodological approaches, methods, projects to accelerate the innovative development of the economy. But unfortunately, almost all developed patents in our state are transferred to the property of foreign states or citizens.

Therefore, it is necessary to use developed patents in Ukraine to solve this problem. It is advisable for the government to develop a long-term innovation strategy, which should be part of the overall economic strategy. Also, the government should return to itself the functions of the choice of priorities (the relevant documents

defining the vector of economic development of the country should be discussed, adopted and implemented). This will give an impetus to innovation and research, as it becomes clear what should be focused on.

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## MAIN DIRECTIONS OF INNOVATIVE DEVELOPMENT OF UKRAINE BANKING SYSTEM IN MODERN CONDITIONS

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Nowadays, the problems that arise in the social and economic life influence on the state of the banking system, causing problems in the area of the formation and resources use. In modern world, the ability to react to changes in the market and its resource base is the main mechanism for achieving a high economic efficiency of any organization. At the time of the information society and the rapid growth of human economic and technological awareness, organizations are introducing new resource bases to meet new consumer needs. So, there is a need for innovation.

The banking sector of each country with a well-functioning economy is the center of innovative products and results of personal intellectual activity. Technologies implementation in countries with economies in transition, including in Ukraine, is a rather complicated process, because it requires significant financial resources [1].

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Innovative development of the banking system can be characterized as a process of the banking system structural improvement, which is achieved through the practical use of new knowledge for improving the banking services quality, raising the level of banking information protection, raising the level of banks competitiveness and, as a consequence, the banking system as a whole.

Today, trends in the development of technological innovations in the banking sector are associated with the dynamic IT sphere development. In our life many banks are reviewing their IT infrastructure in order to optimize and introduce new technologies that will minimize costs for the banking business and gain competitive advantage. For example, today projects for the introduction of video conferencing are the most popular IT projects in the banking sector.

On the one hand, these are costly projects, since there is a need to use powerful channels with high throughput and reliability, and on the other – such projects will allow banks to receive significant savings on business trips of bank employees. But projects related to the introduction of banking products provided over the Internet, that is through Internet banking are the most popular in today's economic conditions [2].

Along with Internet banking, "mobile banking" has equally important influence on innovation. Another innovative product is the free Square Cash service, which was developed by Square in the second half of 2013 and allows users to transfer funds to each other via e-mail without paying a commission. The essence of the technology is that the user sends the corresponding message to the email address of the payee, indicating the amount of the letter subject. After that, the payer and the payee link their debit card email addresses, which allows you to continue sending funds without re-entering the payment card data, with funds credited directly to the payee's bank account [3].

A new trend in banking innovation is the banks convergence with social networks. Currently, advanced projects in the field of banking innovations are client identification projects for photography in social networks. So, Socure has developed a Perceive program that uses the biometric parameters of the client to authorize it in the mobile banking program. The system examines the image of the client, made on a smartphone and compares the picture with a photo on the networks Facebook, Twitter and LinkedIn. After checking, the system accepts a payment, or includes an alarm. Today, the system is used by several London banks in testing mode [2].

The determined list of innovation activity directions is regulated by the innovative management development complex of the bank. Innovative complex provides management of planning and budgeting processes of innovation development, incentives and motivation of personnel, control over the implementation of innovations, information provision of the innovation process, management of organizational and economic development.

In Ukraine, the level of innovation potential is quite high, but at the present stage it is not realized in full. According to the general laws of the economy there is a stable dependence between financial stability, efficiency, competitiveness and innovative potential of the bank, therefore financial innovations play an important role in their provision. Unfortunately, in our country the practice of financial innovations that are implemented by state banks is insignificant. At the same time, a significant share of innovation initiatives exists in the segment of commercial banks. Ukrainian banks usually involve the experience of their western partners, which makes it impossible to obtain their own experience and their own unique developments, but reduces the cost of creating new products, testing and testing. So, the system of online verification of BankID is being implemented in Ukraine. The system is a joint project of PrivatBank and Oshchadbank, and is designed in a manner and likeness to systems that have long been used in the UK, Sweden and Finland. The system allows you to confirm the identity of the user on the Internet, using his bank details, and works on the principle of verification through Facebook. This innovative program allows you to prevent fraud with bank accounts and plastic cards. At the current stage, the largest Ukrainian banks such as PrivatBank, FUIB, UniCredit Bank, OTP Bank support the function of Internet banking and create their own cabinet on their official websites [4].

Consequently, the innovative banks activities provide new opportunities for their progressive development, but at the same time it increases the pressure from traditional and new competitors, which requires the development and adoption of non-standard, rapid decisions concerning the strategy of banks development. And in order not to lose competitive advantages, banks need to improve their operations and services, to introduce more sophisticated management structures that allow flexible responsiveness to the variability of external operating conditions, and ensure high quality banking, cost control and efficiency. The introduction of banking innovations can increase productivity, efficiently use resources, increase profits, reduce costs and, consequently, increase the competitiveness of banks and the banking system and ensure their sustainable development in the global economic environment.

Innovative technologies play a very important role in our time. When it is creating process of the future bank, innovative technologies in the banking services are that technologies which have a "strategic effect" on the growth of the client base, reducing the cost of banking operations with the optimal operational risk level and operating costs. The main global trends in the banking innovations development are the close relationship between the bank and the client, the bank integration in the IT sector, the banks interaction with social networks and the involvement of the latest technologies.

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# INNOVATIVE BUSINESS PLAN MODELLING WITH A VIEW TO IMPROVING THE EFFICIENCY OF THE INNOVATION MANAGEMENT PROCESS

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Formation of market cooperation of subjects of innovation activity, including the first and the last stages of innovative project development, is based on identifying the main basic fundamentals of business mechanism for forming the system of enterprise innovative development, which is best reflected in the process of modelling innovation management in the form of an innovative business plan.

The innovative business plan should take into account the degree of innovation of a product, which will determine the direction of marketing research, internal firm analysis of technical and economic opportunities of the enterprise, and risk assessment.

The model should be formed by the system "conditions-tools-organization" of innovative development. The block "organization of innovative development" will consider all stages of the innovation process as the implementation [1, p. 170].

Creating an innovative business plan enlarges most of the disadvantages of a regular business plan:

1. The business plan in the theoretical design involves the filling of several large sections, the compulsory formation of them may increase the research, ensure the availability of inaccurate, lagged, and aggregated information that is not yet fully

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specified for the innovative idea, and this will lead to a large number of research iterations.

2. Execution of a large number of tasks in each section provides for an increase in the number of impact factors, leads to the modification of the idea and the loss of its relevance.

3. Cumbersomeness of a business plan can lead to the transformation of the original idea into another concept and, accordingly, the need to work out a few variants.

In order to identify the novelty of the product, it is worth using the "productmarket" matrix, which will help to identify the benchmark for writing an innovative business plan.

After analysing the matrix, the entrepreneur can determine the goals of the enterprise's innovation strategy and release the innovative business plan from unnecessary studies [2, p. 182].

The idea of an innovative business plan can be provoked by own needs in the resources, needs and tasks of the state and municipal authorities.

Special principles take into account the features of creating a certain type of innovation project and the level of needs satisfaction. These include profitability, level of efficiency, and degree of achievement of innovative strategic goals of the enterprise and its investment attractiveness.

Principles of forming an innovative business plan of the enterprise consider systematic and complex nature of the organization, making compromise decisions in the process of choosing an idea, satisfying consumer needs, the flexibility of the system, and orientation to the innovative way of development.

The content of a typical innovative business plan includes the following sections:

1. Summary. This section defines the main idea of implementing an innovation project, identifies key stakeholders.

2. Enterprise. This section covers information about the place of implementation of the innovation project (advantages and disadvantages), the main events that will affect the operating result, specify the size of the authorized capital, information about those depositors holding controlling stakes and those having a stake of more than 5%.

3. Products. The main focus of the section is made on the exclusivity of the new product, its distinction from the existing in the market.

4. The analysis of the market of products involves assessing the potential demand for the innovative product of the enterprise.

5. Competition. The section provides an analysis of the information about the potential competitive environment, the probable strategies of competitors and their technical and economic capabilities to enter the market with a similar product.

6. Marketing. The purpose and strategy of innovation marketing are here determined. The complex of marketing is formed, the budget of the marketing service is determined.

The definition, in our opinion, is not entirely complete since the marketing communication environment is determinant but not the only factor determining the market success of the commercialization of innovation.

The conduct of patent and marketing researches of innovation activity makes them an integral part of the process of innovation management in the system of innovative development of the enterprise and determines the benchmarks for an innovation strategy developed at the enterprise.

7. Production process. The section is based on information on the description of the technological process.

8. Organizational plan. It contains the provisions on the construction of an organizational structure, an employee incentive programme, a calendar plan of the newly created enterprise.



**Figure 1. Innovative business plan model in the process of innovation management** *Source: developed by the author based on [3, p. 238]* 

9. Risk assessment. It includes a list of possible risks for implementing an innovative business plan, ranking them in descending order of the probability. The relevance of this section is determined by the uncertainty of information about the environment for the realization of innovative products.

10. Financial plan. It consists of the innovative project's funds flow statement. We believe that particular attention should be paid to different types of costs associated with the place of implementation of innovation.

Designing an innovative project, taking into account marketing, organizational, technical, and creative principles, is intended to solve tactical and strategic tasks in close interaction of the organizational units with a long-term focus. On this basis, one can develop a model of the innovative business plan of the innovation process (Figure 1).

Each phase of the lifecycle of an innovation project involves the presence of its participants and the list of works. A formation of the amount of costs and a preliminary assessment of innovation from idea to commercial implementation in the form of a product or its documentary form as a patent take place at each stage.

The organization of the system of innovative development under fierce competition of enterprises for the best conditions of production and sale is possible only due to creative search, innovative culture, and the creative system which stimulates it. The creative component of the system is integrated into innovative culture formed on the basis of organization and is based on the principles of creativity of management activity, which in the future will ensure the commercial success of innovation, regardless of the ways of use.

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## **CLINICAL SURVEY MANAGEMENT – CHALLENGE OF THE DAY**

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Clinical survey is an important stage in the development of modern medicines for both Ukrainian pharmaceutical manufacturers and for global pharmaceutical companies. Due to this survey, pharmaceutical products, the efficacy of which is proved and investigated safety profiles are available to the pharmaceutical market, while the patients have access to innovative treatments. On the other hand, the development of clinical survey contributes to the creation of new jobs, as well as the introduction of a medicines in the production and health care system.

Ukraine has high potential for its inclusion into international clinical survey projects, which in their turn, in a difficult economic situation, will provide free access to innovative drugs and advanced medical technologies for patients. Furthermore, foreign investments in the health sector by pharmaceutical companies can improve the overall trade balance of the country (services export), increase the volume of financing to the economy and the health care system of Ukraine.

Clinical survey, as a kind of experimental research, put forward stringent requirements for ethical aspects, management, planning, organization, monitoring, reporting and other components. The quality assurance of these components is impossible without highly trained personnel who have undergone appropriate training.

Maintaining and proving the proper level of professionalism is becoming more and more relevant to employees as test sites, as well as pharmaceutical companies and contract research organizations. The process of studying during various trainings, the quality of which differs widely and does not always meet the current educational requirements and their value, cannot be adequately equal to the special education of the respective direction. In our opinion, the most profound knowledge, including the ethical aspects of clinical survey, its administration, planning, organization, observation (supervision, monitoring), reporting, etc., can only be obtained within the course of studying at a higher educational establishment, where it is possible to qualitatively, fully and comprehensively prepare a specialist. Only a profile university can provide an appropriate level of teaching and methodological documentation and knowledge control. A full-fledged educational program should provide an opportunity for professional development and improvement of a specialist of any level.

Taking into account the realities of time and international requirements in the field of clinical research, on the initiative of the Department of Clinical Pharmacology and Clinical Pharmacy, the Department of Management and Administration, supported by

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the National Pharmaceutical University's rectorate, opening a new educational and professional program "Management of Clinical Research" was proposed for the second (master's) level in the field of knowledge 07 Management and administration, specialty 073 Management.

In order to determine the need for training specialists in the field of clinical survey management in Ukraine, an analysis of informational references regarding the examination of materials of drugs clinical trials by the Department of Expertise of Preclinical and Clinical Trials Materials of the State Expert Center of the Ministry of Health of Ukraine for the last five years was conducted [1], the number of test sites (TS) in Ukraine involved in the implementation of clinical trials was estimated [2]. According to the results of the survey, we can say that today, approximately 7 large contract research organizations (CROs) are active on the market of clinical research of Ukraine. They applied for 40-55% multicenter clinical trials in our country, as well as 38 smaller CROs (45-50% of studies). Each of these CROs includes at least 5 people who are directly involved in the planning, organization, conduct and monitoring clinical trials.

Domestic applicants for pre-registration clinical trials usually do not involve TS for clinical trials, but have their own structural units that deal with this issue. According to our estimation, 5 large producers (which provide up to 55-70% of pre-registration trials), as well as 14 smaller ones, work steadily in the domestic market of clinical research. The structural divisions dealing with clinical trials in each of these enterprises comprise an average of 5-10 people. Thus, we can conclude that in Ukraine at least 500 people work in the field of clinical research as part of the structural subdivisions of domestic pharmaceutical production.

Estimation of the number of domestic TS involved in the implementation of clinical trials has demonstrated that their number in the last 5 years varies within 500-700 units. Each of these TS performs from 1 to 10 clinical trials, thus we can assume that at least 1,000-1500 doctors are performing research as responsible investigators, survey coordinators and doctors, co-researchers, quality specialists, etc. Taking into account all of the above, the estimation of the labor potential of domestic specialists involved in various functions in the field of management of clinical trials is approximately 1500-2000 people having different basic education and experience in the trials.

In addition, in order to substantiate and assess the need to open a new educational and professional program "Clinical Survey Management" in Ukraine for the second (master) level in the field of knowledge 07 Administration and Administration, specialty 073 Management, the Department of Clinical Pharmacology and Clinical Pharmacy at the National Pharmaceutical University held 2016-2017 the questionnaires with the specialists of the research sites (TS), CROs, pharmaceutical manufacturers – survey sponsors and staff of the State Expert Center Ministry of Health of Ukraine, involved in planning, conducting and evaluating CR and their regulatory control. The total number of respondents was 193 specialists in the sphere of CR (61% – women, 39% – men) at the age of 22-55 years old.

The distribution by education demonstrated that 166 people (86%) have medical education, 9 (4.7%) – pharmaceutical, 7 people (3.6%) – biological or other education, and 4 respondents (2.1%) have two educations, one of which is medical.

It should be noted that 87 respondents (45%) participated in more than two CRs (39 of them (20%) conducted 3-5 CR), 61 respondents (32%) 1-2 CR, while 45 respondents (23%) did not take part in conducting CRs, but plan to do this in the near future.

The distribution by the workplace demonstrated that among the respondents there were 73 representatives (37.8%) of medical and preventive care establishments (MCE/PCE), 62 members (32.2%) of medical/pharmaceutical high educational establishments, 10 employees (5.2%) of pharmaceutical companies, contract research organizations (CROs) – 10 people (5.2%), 23 representatives (11.9%) of regulatory bodies and others – 7 persons (3.6%). It should be noted that respondents (4.1%) noted two places of work, one of which is MCE/PCE, and another is CRO, pharmaceutical company or regulatory body.

The analysis of respondents' opinions regarding the ways to ensure the quality of work of those involved in clinical trials and bioequivalence showed that, in general, 68.6% of respondents considered appropriate to obtain special managerial education in this area; 15.7% consider the regulatory and regulatory support for these studies to be sufficient, as well as the establishment of a system of standard operating procedures at all levels involved in such survey; 7.8% respondents consider that periodic trainings in the performance of the functions of planning, organization, monitoring and compliance with the ethical requirements of clinical research, as well as on the issues of Proper clinical practice and modern regulatory requirements for conducting clinical trials is sufficient; 17.8% of respondents consider it necessary to implement all of the above-mentioned components.

An assessment of the importance of proper education for conducting clinical trials and bioequivalence was conducted on the following scale: "yes" – new educational services for clinical research are needed; "No" – not necessary; "I do not know" – I do not have a clear idea on this issue. A qualitative analysis of this assessment, based on the results of a general survey of specialists, demonstrated that the expert opinions regarding the correspondence of existing educational services to the requirements and realities of today were divided as follows: 64% – research site managers, 33% – survey doctors, 42% – regulators and 57% – monitors (employees of pharmaceutical companies, industries, contract research organizations) consider it necessary to open a new specialty in clinical research.

The combination of the results of both studies allows us to conclude that there is a significant need for training specialists in the field of clinical trials in Ukraine under the new educational-professional program "Management of clinical trials" (educational qualification level "Master", specialty "Management", Public Health Manager (Public Health Manager)", while the target audience of potential applicants for this program today is approximately 500 people. The opening of such an educational and professional program will facilitate the expansion of the health care institutions', pharmaceutical manufacturers' and scientists' capacity to engage in

international survey projects and deepen the integration of our country into the world of scientific and industrial space.

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# TRANSFORMATION OF THE ROLE OF STATE IN ECONOMY IN GLOBALIZATION CONDITIONS

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The financial crisis of 2008-2009 has demonstrated the lack of theoretical research on the state as a public goods and services producer and on the optimal scale of state intervention to the institutional structure of the national economic system as well.

The dominant scientific paradigm of the interpretation of the essence of the interaction of the state and the market, based on neoclassical approaches and views of other economical schools' representatives according to which the state is devoted to increase the level of market efficiency by eliminating its "failures", proved to be imperfect due to the inability to explain modern institutional transformations [1, p. 421].

The globalization processes' strengthening has substantially changed the understanding of the public finances essence and led to the evolution of theoretical approaches to their interpretation. The traditional public finance theory based on the welfare and public choice focuses on the formation of the revenue and expenditure part of the central (state) and local budgets, examines the mechanism of their interaction in the context of financing public goods and services. A new theory of public finance considers the interaction of the state and the market in the context of cooperation and competition between public and private market agents regarding the provision of public services and takes into account the need for concerted action of governments at the national and international levels to address global development challenges, especially in the face of aggravation of the crisis phenomena in the economy.

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Under conditions of globalization, when the economy goes beyond the bounds of the state, the problem of interdependence between the state and the economy becomes of particular importance for economic methodology. Economic determinism' followers associate this process with the dismantling of state institutions in general, with the self-liquidation of the state as such. Instead, A. S. Galchinsky believes that this problem is associated with a profound systemic reconstruction of state functions, which are due to the controversial process of becoming a post-industrial, global society [2, p. 471].

We are agree with Galchinsky's opinion that the modern global information economy, which operates on-line, is based on a fundamentally different basis. A new understanding of the need for a systemic separation of political power and economy is going to change the previous Keynesian and Neo-Keynesian approaches based on the state's functions expansion. It is about the limiting of state's economic function and developing new mechanisms for economy regulation, which will be formed within the economy itself.

Global economy changes have forced the scientific community to return to basic questions about the state: what should be its role, task, function, because the sustainable development – both economic and social – is impossible without an effective state. The lack of an adequate theoretical basis for interpreting the state's role and its functions in national economies negatively affected the prospects of exit from the structural and financial crisis [1, p. 422].

In the current multifaceted, mixed market economy, the state plays an active role in shaping the most important processes of socio-economic development. The public sector has a dominant position in the economy due to using resources to finance stateguaranteed public services and various income redistribution programs. The public sector also plays an important role in the financial markets of most countries, owing to significant amounts of its borrowing from the private sector and a substantial amount of its assets in the economy. The public services financing and the income redistribution in most countries of the Organization for Economic Cooperation and Development (OECD) exceeds 40% of GDP, and in some countries it even approaches 50% of GDP [1, p. 430]. The state's influence magnitude is particularly increasing in the period of aggravation of the economic and social situation in the country. In periods of stable development and absence of crises, the scale of government influence is shrinking and the state, like other market agents, operates within defined long-term programs and strategies.

The growth of the state's role in the income redistribution is inherent in all European countries. Their common feature is a significant share of public expenditure in GDP. It can be argued that in most countries with a developed market economy, the indicators characterizing the budgetary burden are comparable. Due to the integration of economic, financial, currency, and credit systems in European countries, the convergence process has taken place – equalizing the value of financial and budgetary indicators, in particular, the budget deficit, public debt, inflation, interest rates, etc. Among the main benefits of such integration is the coordinated, even development of all EU Member States. The disadvantage of such an association

is the particular country government inability to accelerate its own economy development.

In order to compare the EU countries and Ukraine budget structure indicators correctly, the amount of deductions to extrabudgetary funds (pension and social), which were also reflected in the social benefits indicator, was added to the Ukrainian budget expenditures (Table 1).

Table 1

| Indicators      | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|-----------------|------|------|------|------|------|------|------|------|
| EU-28 countries | 50,0 | 48,6 | 49,0 | 48,6 | 48,2 | 47,4 | 47,2 | 46,9 |
| Ukraine         | 45,9 | 42,7 | 46,1 | 46,3 | 44,6 | 45,0 | 45,8 | 45,2 |

Budget burden in EU-28 countries and Ukraine, % of GDP

Source: compiled according to the statistics of the European Union (http://appsso.eurostat.ec.europa.eu) and the State Statistics Service of Ukraine (http://www.Ukrstat.org)

According to the data, the budgetary burden in Ukraine is slightly lower than in the EU zone's countries, but the domestic indicator is characterized by considerable volatility and the opposite trend direction for its changes. If in European countries there is a tendency to decrease or stabilize the growth rates of budget expenditures, in Ukraine, their uneven gradual growth occurs.

Before consolidating the budget and looking for mechanisms for its implementation, it is necessary to clearly determine at the state level what the demand or supply economy the government is trying to build in the country, since it will depend on the choice of directions and volumes of budget funds spending.

The all leading countries' governments have faced with the impossibility of constantly stimulating demand in the context of the global economic recession. Due to restrictions on public investment, falling living standards, reducing the private investment volume and the unavailability of credit resources, the proposals to return production to the metropolis are increasingly being heard as one of the options for anti-crisis maneuver of states, which can reduce unemployment and create new jobs.

There is a question for the world about the transition to a new model for building economic relations – the economy of the proposal, which involves modernization as a basis – production, and its superstructure – the nature of public relations. And the fiscal policy forms and reflects the type of state economic model.

The state must concentrate its limited resources on clearly defined basic functions. Budget policy should be based on the relative state participation effectiveness assessment in various economic activity's spheres and minimize the budgetary resources distribution in areas where the state's participation is unnecessary or ineffective.

In the context of the globalization and the transparency of most economies in the world, when crises are of an all-embracing nature, and among the factors that trigger them the institutional ones become dominate, we must talk about the decisive role of the state in overcoming the crisis phenomena, the need for intervention in market mechanisms and the introduction of manual control of the situation. At the same time,

it should be emphasized that the modern socio-economic structure of Ukraine, which was formed as the economy institutional transformation result, is characterized by the strengthening of the state's role as a public goods producer, as is the case for most European countries.

In the context of fiscal consolidation and post-crisis economic recession, it is imperative to reduce the social benefits list and state support directions. At the same time, the social benefits' total amount received by one person per month can not be higher than the subsistence minimum. It is necessary to legislatively fix restrictions on the maximum for the social assistance's amount per person. It is also necessary to determine clearly which categories of citizens need state social assistance and on what criteria such categories of population will be determined [3, p. 331].

It is necessary to return to the ideology that a person should work to keep himself and his family safe if he has no restrictions on his health or for other reasons. The state is not obliged to give money to citizens, but only to create conditions for obtaining work. Therefore, the priority task is to prepare public opinion for the transition to a new model of relations with the state. Such an initiative should come not only from the state, it is necessary to involve public organizations and scientists to explain the irreversibility and the need for such transformations, to highlight the benefits that citizens of most democratic and market-rich countries of the world already have.

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## LAND RESOURCE POTENTIAL AS A BASIS OF EFFICIENT USE OF LAND

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The issue of rational use of land resource potential has been always actual. Nowadays, sustainable development is the most important and common problem. Sustainable development means achievement of a harmonious balance between

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population, consumption and capability of land to support living. In other words, one should take from the land as much as it allows, not deteriorating and not exhausting its soil and vegetation layer and ecosystems, i.e. to use land resource potential in a rational way.

Under conditions of reforming of ownership and establishment of market relations in Ukraine, rational use of land resource potential influences structural and ecological balance of the land fund, intention of its use, reclamation of soil fertility, functioning of landscapes, and efficiency of land use in agriculture.

Land resource potential is a condition to secure sustainable development, a precondition for stable performance, a base of economic safety of a region. Under conditions of market economy development, the concepts of "potential" and "resource" are getting close in their meaning. Thus, potential of agricultural production should be considered as a complex of land resources, necessary for their performance and development. Land resources make a territorial basis for social production, improve and increase their productivity due to efficient use. It is also effective to use land in the way, which secures scientifically argued economic effect of farming and improves soil fertility and ecological conditions of the environment. Moreover, a complex of organizational and economic measures is focused on protection and reclamation of soil fertility, ecological balance of landscapes, improvement of other useful properties of land and environment [3].

Lviv region is an area, which has potentially effective land resources. Total area of the region constitutes 2183197,4 ha, including 1292655,3 ha of agricultural land, i.e. 59,2 % of the total area. At the current stage of establishment of the regional economy, an important step is to determine indicators of economic potential of land resources of regions. On the other hand, economic potential immediately depends on development and structure of agricultural branch of production on some territory. Efficiency of the resource potential use is a proportion of the obtained results of production and the employed resources. A maximum of the obtained results at minimum costs is considered the criterion of efficiency. Growth of gross output is a principal indicator in assessment of land resources use.

Principal indicators for assessment of the efficiency of economic potential of land resources on the territory of a region include a level of security of the national economy with agricultural products, population with food products, industry with raw materials, and trade with food products. Economic indicators are a concentrated expression of quality and quantity transformations in agrarian economy. Their values are changed depending on development of agrarian production and depict its objectivity and expectancy [2]. Level of agricultural production is mainly influenced by the land content. However, efficiency of land use is influenced by many factors, particularly level of productive forces development, degree of land plowing, structure of cropping area, share of drained land in the total area of agricultural lands and, to some extent, by legal status of lands, i.e. a form of ownership. Rise of the efficiency of land resources use is one of the most important problems of the national economy. Successful solution of the problem can contribute to efficient performance of agricultural enterprises.

Rational and efficient use of land by agricultural enterprises can be supplied by taking measures concerning improvement of soil fertility, protection from erosion and other destructive processes. Considering national interests, society should employ land so it can stay improved for the future generations. Introduction of the achievements of scientific and technical progress and intensive technologies in agriculture objectively requires consideration of not only their positive impact on land, but possible negative effects, caused by specific impacts of some production means. Thus, one can distinguish the following main directions for improvement of the economic efficiency of land use in agriculture:

- 1) a system of measures concerning improvement of land fertility;
- 2) protection of soil from erosion and other destructive processes;

3) reduction of the area of land, intended for conservation and layland. Economic efficiency of production resource use in crop production substantially depends on the level of soil fertility. Dynamics of the content of humus in the soils of different zones of Ukraine confirms that growing of high yields of agricultural crops, under conditions of a deficit-free balance of humus, requires increased application of organic fertilizers. It is necessary to apply 10,5 ton of organic fertilizers per 1 hectare of arable lands, including 14 ton – on Polissia area, 11 ton – in Forest Steppe, 9 ton – in Steppe. Diversity of natural conditions causes the necessity to introduce a scientifically argued system of agricultural farming, which expects increase of soil fertility, improvement of agricultural land quality. Thus, the system of arable farming is a key constituent of the system of agricultural production. It secures an optimal use of land resources in terms of complex interdependent agro-technical, reclamation and organizational-economic measures, focused on efficient use of land, protection and increase of soil fertility, obtaining of high yields of agricultural crops. The system of arable farming should make structuring of cropping areas, determine the system of crop rotation, soil treatment, fertilization, seed production, measures of fight against weeds, pests and diseases of agricultural crops, system of reclamation measures, soil protection from water and wind erosion, environmental protection. Farms should increase the number of soil-protective measures and methods of land tillage, as well as anti-erosion measures. Landowners and land users have to take measures of soil protection from wind and water erosion, prevent salinization, swamping, and weed growing, as well as other processes, which deteriorate soil conditions.

A complex system of land protection expects introduction of soil-protective crop rotation, subsurface soil treatment, soil-protective technologies of agricultural crops growing, field-protective forests and other anti-erosion measures. A soil-protective plowless system of arable farming should secure intensification of crop production branches, reclamation and improvement of soil fertility. Such measures will contribute to increase of yield of agricultural crops, reduction of labor consumption and costs per a unit of products. Introduction of soil-protective systems of arable farming stimulates reduction of erosion-dangerous areas of soil, because annually, the area of arable lands is sufficiently reduced in Ukraine due to increase of ravines, while erosion processes cause loss of 3,5 million ton of mineral fertilizers (calculated as 100 % of nutrients) at fields and pastures.

Thus, the concept of "land resource potential" is characterized by an aggregate of resources of a land area, which determine ecological conditions of life and settling of people, are used for placing of production means and have biological productivity for economic activity. "Its rational use" expects a triunity of a harmonious combination of ecological, economic and social directions.

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# THE HEALTHCARE MODELS: GLOBAL BACKGROUND AND UKRAINE'S DEVELOPMENT

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The healthcare pattern is a key component to influence the formation and development of the whole healthcare system in a country. Each country has made its own system of the health care that reflects historical and economic changes, cultural differences, political and social environment, the evolution of civilization and the progressive globalization. However, all of them are merely consigned to basic funding models for the healthcare system.

Around the world, they used to distinguish several basic models of funding the healthcare system: the Bismarck Model (or German model); the Beveridge Model (or English model); the National Health Insurance Model; the Out-of-Pocket Model; the Private Insurance Model; the Semashko Model (or the Soviet model).

The world's first healthcare model became the Bismarck Model. Founded in the end of XIX century it was named for German politician, Otto von Bismarck. The model is based on mandatory social health insurance. Medical care is financed partly by ring-fenced contributions from employers and partly by the employees. A distinctive feature of the Bismarck Model are the private insurance funds controlled by state or private insurance companies and heavily regulated by the

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government [3, p. 128]. This model has been adopted for the healthcare systems of Austria, the Benelux countries, France, Germany, Italy, Japan, Sweden, Switzerland [1; 3, p. 128].

The Beveridge Model is a healthcare system that emerged in Great Britain in 1948. It was named after William Henry Beveridge, the British economist and politician. Specific characteristics of the Beveridge is its universal health care coverage for all citizens, which is state-funded from general and regional taxation. The decision on the total amount of funding is made in the process of planning the total government spending for the country [3, p. 127-128]. This model has been adopted for the healthcare systems of Cuba, Denmark, Great Britain, Ireland, New Zealand, Spain [1; 3, p. 127].

The National Health Insurance Model combines some aspects of both the Bismarck and Beveridge models. As in the Bismarck model, the providers – that is, insurance companies – are private and, as in the Beveridge model, the government finances healthcare through tax revenue. The balance between private practice and government regulation helps to cut the costs associated with the administration of health insurance [5, p. 84]. Classic model of the National Health Insurance is applied in Canada, yet some other countries, for example South Korea and Taiwan, has adopted it as well [1].

The Out-of-Pocket Model is prevalent in poor countries where the gap between the rich and poor is substantial. Due to the lack of resources to provide mass medical care, the patients have to pay for medical service out-of-pocket. This model differs in that the rich have the access to medical care while the poor stay sick or die [5, p. 84]. Examples of the Out-of-Pocket Model include rural regions of Africa, China, India, South America [1].

The Private Insurance Model is typical to the United States of America. The healthcare is based on two main government programs – Medicare and Medicaid. Patients themselves pay for medical services and get later payments from the insurance company or reimburse the insurance value of treatment directly to the medical institution. This model is considered the most efficient in the world [3, p. 128].

The Semashko Model refers to the Soviet pattern of the healthcare founded by a doctor (physician), Mykola Oleksandrovych Semashko, after the October Revolution in 1917. This system functioned through the centralized five-year development planning. Medical care was funded through the government spending. The Semashko Model granted a universal access to free medical care, where all citizens had a right for medical treatment [2, p. 2].

Ukraine, as the other former republics of the USSR, has the Semashko Model. In due time, the Soviet model was a progressive pattern, yet it is gradually passing away nowadays. Today, Ukraine is in transition to the social insurance model that is going to be the closest to the Beveridge Model, implementing the concept of "money follow a patient". The idea of the concept is to pay health institutions for the treatment served out of the state budget, through the National Health Service of Ukraine, instead of the estimated spending for hospitals, doctors and inpatient beds, as it was with the Soviet model [4].

Summing up, we may argue that given the variety of funding models for the healthcare system, there is no universal model that fits all countries. It is essential for the model to be efficient and meet the needs of the patients. The social insurance model implementation is one of the priorities of medical reform, which contributes to the development of modern Ukraine. In the process of reforming Ukrainian healthcare and constructing its efficient system, it is suggested to adopt international experience and adapt to Ukrainian environment.

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## **ENVIRONMENTAL TAXATION: EUROPEAN EXPERIENCE**

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Taxation is a reliable instrument of business activity. It plays an important role in the economic system stimulating rational natural resource management and minimizing negative impact on environment. Intensive development of world's economy challenges global ecology, which has become a subject of international concern. Environmental taxation is expected not only to raise state budget income, but also to introduce sanctions against polluters, to make industrial production ecologically safer, to stimulate economy modernization with implementation of environmentally friendly technologies. This approach helps preserve natural resources.

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A number of modern scientists have completed initial researches on complex approaches to environmental taxation. It is a current issue of further research: many questions remain unanswered. Approving changes to the Ukrainian Tax Code requires thorough examination of environmental taxation in EU countries, aiming to implement their experience into domestic system.

Environmental taxation system is available almost in all postindustrial developed countries with market economy, particularly in EU countries. European Union is one of the world's leaders in environmental taxation introduction and development.

According to EUROSTAT, EU countries collected around 364.4 billion euro (2.44% of average EU GDP) of environmental taxes in 2016 [1].

According to the available data, Great Britain collected  $\in 58.3$  billion, Germany –  $\in 58.5$  billion, Italy –  $\in 58.8$  billion, France –  $\in 49.7$  billion, Poland –  $\in 11.6$  billion, Denmark –  $\in 11.1$  billion of environmental taxes in 2016.

In 2016 environmental taxes accounted for 3.99% of GDP in Denmark, 3.5% in Italy, 3.11% in Finland, 2.77% in Bulgaria, 2.72% in Poland (2.44% of average EU GDP).

These data demonstrate high level of economy's ecological safety in countries with market economy.

Research on environmental tax as a part of EU GDP in 2012-2016 highlights ups and downs of its revenues. Environmental tax income increased by 0.43% in Portugal, 0.27% in France, 0.13% in Finland and Poland; on the contrary, there was a decrease in its rate by 0.25% in Germany and 0.18% in Sweden (EU average data fluctuations are insignificant).

Environmental taxes are an important part of general taxation revenues in EU. According to 2016 data, Bulgaria was on the top of environmental tax revenue list with 9.57% of general taxation income, 8.43% in Denmark, 8.16% in Italy, and 7.91% in Poland (6.11% of EU average).

In 2012-2016 Portugal and Norway demonstrated an increase in environmental tax revenues from 6.27% to 7.02%, and from 5.68% to 6.23% respectively; on the contrary, there was a decrease of this indicator in Germany, Sweden and Bulgaria from 5.38% to 4.60%, 5.57% to 4.99% and from 10.00% to 9.57% respectively [1].

Energy taxes are an important structural part of environmental taxation of all EU countries. The biggest share of energy taxes was marked in Denmark and Germany. Since the second half of the 20<sup>th</sup> century, a number of EU countries introduced energy tax on fuel resources. Denmark receives highest revenues of all EU countries. Tax is a component of the final price on natural gas for industrial consumers in the Netherlands and Romania [2].

Environmental taxation of electric energy is expected to stimulate the development of wind power, small hydropower and other renewable sources of energy.

Integration of environmental taxation system is eventually taking place in the EU. The list of environmental taxes, as well as the number of ecologically unfriendly goods and materials, becomes shorter [3].

European countries run into certain issues in environmental taxation system casting a negative effect on economy. Environmental taxes can result in slumps of production and sales (mainly in the branches connected with natural resources) consequently resulting in unemployment growth. It is also important to mention that environmental taxes negatively influence polluters' competitiveness.

The perspectives of environmental taxation optimization in EU require further discussions. After the USA exit the Paris Climate Agreement, activation of environment protection policy became a pending issue in the EU. According to the author's opinion, carbon tax (greenhouse gases tax) introduced in all EU countries, can become an important financial tool fighting climatic changes.

Environmental taxation system in EU has proved its efficiency. It casts a systemic positive influence on environmental quality, stimulates the growth of ecological production, minimizes ecological risks, and creates ecologically safe living and working space.

"Green growth" conception is a subject of important concern in EU environmental taxation policy. It helps find out and promote new potential sources of economic development with limited impact on nature. Transition to green economy is based on complex environmental tax and budget measures, taken for green business development.

It is important to revise the existing vehicle taxation system in order to stimulate business produce electric transport and make it more advantageous to prospective buyers. One of the options is to introduce tax allowance for battery-powered vehicles and service infrastructure, and cancel it for diesel engines.

Domestic environmental taxation system in Ukraine faces certain difficulties. Positive experience of EU may help develop an efficient environmental taxation system.

Development of environmental taxation system in Ukraine requires implementation of special management and regulation instruments:

- To introduce taxes on ecologically unfriendly materials and items (EU countries administer environmental taxes on a wide range of materials and items, such as tires, batteries, plastic tableware and others);

- To activate introduction of environmental taxes on mobile polluters, agricultural polluters, household and municipal waste;

- Environmental tax is expected to stimulate the industries introduce ecologically friendly technologies and launch optimization production processes, minimizing impact on nature;

- To promote cooperation and coordinate interaction of both governmental and nongovernmental environmental institutions;

– To introduce land tax allowance to agricultural manufacturers producing organic goods;

- To introduce environment tax credits opening tax refund opportunities under condition of investments into systemic ecological modernization of production.

The influence of environment tax on ecologically unfriendly production may become a subject of further scientific research.

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