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CONTENTS

J11409-001

Natalia V. Bogdanova

GROWTH FEATURES OF PIGS OF DIFFERENT GENOTYPES

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The growth rate of young stock pigs of Large White breed have been studied in pure- breeding and interbreeding. Found that a higher body weight and the highest absolute and relative gains of animals at all periods of their age were characterized by experimental animal mixes of ♀LW x ♂ D. By formation intensity values, indexes of uniformity and straine of growth they exceed pure analogues of LW breed, respectively on 13,4; 7,9 and 11,3%.

Key words: pigs, youngstock, live weight, indexes of formation intensity values.

Growing of replacement young stock of pigs should be directed to the formation of healthy, constitutionally strong animals which can show both high and constant reproductive capacity throughout the whole period of intensive use. Technology of obtaining of high-quality replacement young pigs is based on knowing of the individual development patterns of animals that can be implemented in specific conditions of their growing.

Study of individual development of animals is one of the most topical questions of Biological Sciences and Breeding. It is closely linked with the task of further improving of animal productivity, improving of existing and developing of new high-performance breeds [6].

One of the main growth indicators of the pigs is their live weight at different ages. The level of a genetic potential of animals on this basis is affected by both genetic factors and methods of breeding [6].

On the basis of fundamental research [3, 6] found that the indexes for assessing the growth rate of animals are not only the relative and average daily gains but also formation intensity values, indexes of uniformity and straine of growth, which allow

to predict fattening and reproduction qualities. The high prognostic significance of the above parameters are proved. Due to them we can predict the live weight of the animals at their earliest possible age [1, 2, 4, 5].

The purpose of the study. To study the dynamics of live weight, indexes of formation intensity, indexes of uniformity and straine growth of young pigs of Large White breed in pure- and interbreeding.

Materials and methods of research. Experimental studies were conducted in the State Enterprise “Antonov-Agro” of Kievo-Sviatoshynsky district of Kyiv region. Three groups of animals of different genotypes were formed for this planned research (18 heads each): 1 (control) – purebreeding animals of Large White (LW) breed; 2 (experimental) young stock of pigs which were obtained by cross breeding of females of Large White breed with boars of Landrace breed (L); 3 (experimental) – young stock of pigs obtained from females of Large White breed and boars of Duroc breed (D).

The way of feeding and keeping animals were similar. Animals were fed with complete feeds in accordance with norms. Energy growth of experimental animals was determined by weighing the individuals in the age of 2 -, 4 -, and 6 months, the average, absolute and relative increase in body weight gains were calculated. To study the growth patterns of experimental animals were determined values of intensity of formation, straine and uniformity indixes of growth [2].

Results and discussion. Found that young stock of compared genotypes characterized by high growth rate. The data obtained (tab. 1) indicate that the animal research groups had better indicators of live weight, than their analogues of Large White pure-breeding of the control group during the stated period of time.

So, at the age of 2 months the combination of animals ♀ LW x ♂ D characterized by higher live weight – 17,1 kg, where for a mother basis served a Large White breed, and for a parent – pigs of the Duroc breed. The lowest live weight is observed in pure breed gilts from the control group – 15.7 kg, which are, respectively, 0.5 and 1.4 kg less in comparison with analogues of the 2nd and 3rd study groups ($P< 0,05$ and $P< 0,001$).

At the age of 4 months replacement young gilts of research groups had 3,3-13,9% bigger live weight than animals from the control group. The difference in this indicator was accurate between animals of the 2nd and the control groups (P <0.05), and the 3rd and the control groups (P <0.001).

Table 1

Live weight and daily gains of experimental animals

Age, month	Group		
	1 – c	2	3
Live weight, kg			
Newborns	1,04±0,02	1,08±0,01*	1,16±0,02***
2	15,7±0,13	16,2±0,15*	17,1±0,13***
4	39,5±0,22	40,8±0,43*	45,0±0,45***
6	70,5±0,40	72,3±0,75*	79,9±0,57***
Daily gains, g			
0 – 2	244,0±7,53	252,0±8,72	266,0±5,14*
2 – 4	397,0±18,0	410,0±13,0	465,0±22,0*
4 – 6	517,0±21,0	525,0±19,0	582,0±21,0*
Absolute gains, kg			
0 – 2	14,7±0,29	15,1±0,15	15,9±0,18
2 – 4	23,8±0,18	24,6±0,32	27,9±0,37
4 – 6	31,0±0,31	31,5±0,33	34,9±0,33
Relative gains, %			
0 – 2	175,6±1,06	174,57±1,31	173,8±1,79
2 – 4	86,23±1,13	86,32±1,29	89,86±1,24
4 – 6	56,36±1,16	55,70±1,19	55,88±1,16

Note: *P<0,05; **P<0,01; ***P<0,001 in comparison with the control group.

In the age of 6 months gilts of the 2nd experimental group had a slight advantage in body weight (P <0.05) over the control analogues, whereas animals of the 3rd group exceeded (P <0.001) the control analogues at 13, 3% at stated age period.

Found that at the age of 6 months the highest live weight was in experimental young stock of the 3rd experimental group, and they exceeded (P <0.05) the control and the 2nd research groups respectively by 13.3 and 19.5%.

Changes in live weight of experimental animals at different periods of their age depend on the average daily gains. At the age of 2 month young stock of the 3rd experimental group exceeded gilts of the control group on this index by 9.02%; in the age of 4 months – 17.1; in the age of 6 months – 12.6%.

At the age of 2 months the highest (175.6%) relative increase was observed in animals of the control group, which is 1.8% up compared to the results of counterparts of the 2nd and the 3rd experimental groups.

The gilts of the research groups had the above mentioned indexes almost at the same level in this age. A similar trend was observed in changes of the relative increase in live weight in female pigs at the age of 6 months.

For a more objective assessment of the dynamics of live weight and growth of experimental animals, we calculated formation intensity values, indexes of straine and uniformity of growth (tab. 2).

Table 2

Formation intensity values and growth indexes of animals

Group	Intensity of formation	Uniformity growth index	Straine index of growth
1 - c	0,298±0,02	0,469±0,02	0,152±0,005
2	0,307±0,02	0,477±0,013	0,155±0,007
3	0,338±0,03	0,522±0,014	0,164±0,006

Found that the intensity of formation of the animals in the 3rd experimental group benefited the control and the 2nd experimental groups respectively by 13.4% and 10.1%.

Big straine of growth also had gilts of the 3rd experimental group with the combination of ♀ LW x ♂ D. They exceeded the young stock of the control and the 2nd experimental groups respectively by 7.9 and 5.8%.

The animals of the 3rd research group also had good index of uniformity of growth. According to this index they exceeded by 11.3 and 9.43% respectively the control and the 2nd experimental groups. This indicates that the period of active growth of animals of the 3rd group goes without sharp reductions of average daily gaines of live weight. Straine of the growth increases proportionally to the average daily gaines. The formation of young stock to adult animals (age period of 2 to 6 months) goes more intensively in female pigs of the 3rd experimental group, it means that these animals comparing with their analogs are more early maturing.

Conclusions

1. Found that the growth and development of young pigs depend on breeding methods and the combination of genotypes.

2. The highest live weight and average daily gains had cross breeds of the combination of genotypes (♀ LW x ♂ L) та (♀ LW x ♂ D), which dominated by live weight of analogues of the control group in the aforementioned periods of their growth.

3. Changes in live weight of experimental animals at different ages depends on the average daily gains. Young stock of the 3rd experimental group at the age of 2 months dominates the control female pigs on this index by 9.02% in the age of 4 months – 17.1, in the age of 6 months – 12.6%.

4. The highest levels of formation intensity values, indexes of uniformity and straine of growth characterized by a combination of animals ♀ LW x ♂ D which exceeded the control group respectively by 13.4, 7.9 and 11.3%.

5. The research results indicate that the formation of young adult animals (age period of 2 to 6 months) is more intense in female pigs of the 3rd experimental group, it means these animals comparing to their analogs are more early maturing.

6. A further study should be focused on an observation of relationships of growth parameters of body with live weight of animals of different breeds origin.

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J11409-002

Valeyeva A.A.[1], Aleksandrova A.B.[2]

NUMERICAL CLASSIFICATION OF AGROGREY AND AGRODARK GREY SOILS OF THE VOLGA-KAMA FOREST-STEPPE

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In this paper the properties of 237 arable horizons of agrogrey and agrodark grey soils of the Volga-Kama forest-steppe are systematized. Discriminant functions

and classification functions, allowing to determine new agro-grey and agro-dark grey soils of the Volga-Kama forest-steppe are obtained.

Key words: arable soils, virtual image, systematization, numerical classification

During cultivation the arable horizon acquires characteristics which are not typical for natural soil formation. Therefore the need for detailed characterization, collection, storage, systematization and analysis of their change with time arises. One way of studying the properties of arable soils is in comparing them with the properties of their virtual image (statistical standard) which is necessary for the development of agricultural technologies and maintaining the fertility of arable land, based on their natural abilities.

To create the virtual image 237 arable grey forest soils were generalized. They are derived from the data of the National Cadastre Centre "Land" (NCC Land). The data was systematized using Russian classification of the year 1977 [2]. Using the approaches [4-6] and the virtual image of natural grey forest soils of the Volga-Kama forest-steppe [1] we attempted to give a statistical description of their arable analogs, using Russian classification of 2004 [3].

To determine the informative properties a principal component method (PC) was used. PC1 correlated with humus content, absorbed bases content, clay content and describes 58% of the total variance of features. PC2 correlated with pH_K and describes 27% of the variance.

Figure 1 shows the distribution of the arable horizon properties in the PC1 and PC2 coordinates. Systematization of soils according to NCC Land has not identified the grouping of arable horizon properties on the axis of PC1 (Fig. 1A). Systematization according to the virtual image of agrogrey and agrodark grey soils has identified the division of arable horizon properties on the axis of PC1 (Fig. 1B). Mechanical mixing of the low-power humus horizon and the underlying of a humus-eluvial horizon forms a lightweight arable horizon. This horizon is grouped in the negative area of PC1. Arable dark grey soils are characterized by thick humus horizon and form a more compact group in the positive area of PC1 (Fig. 1B).

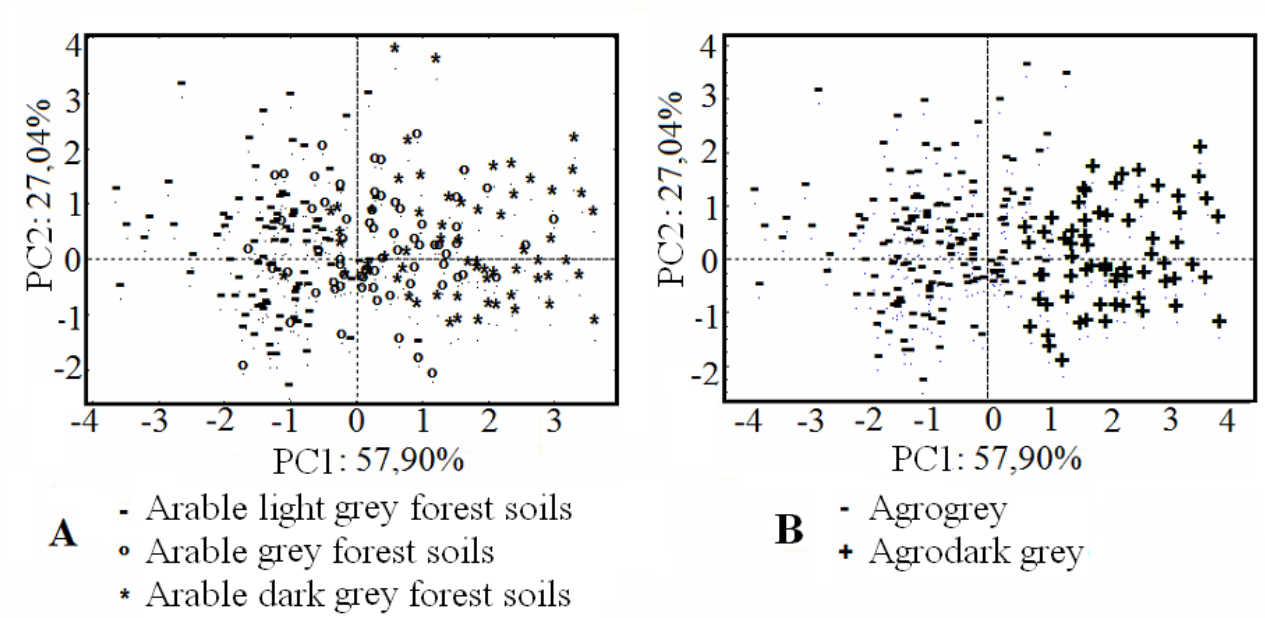

Fig.1. Properties of the arable horizon on the factor plane PC1 and PC2 of grey forest soils: A – systematized according to NCC Land, B - systematized

With the use of discriminant analysis numerical classification of arable horizon of agrogrey and agrodark grey soils was conducted. Analyzing data of NCC Land we identified two discriminant functions (DF), but only the first DF is significant ($p = 0.00$). DF1 is responsible for 99% of the variance and correlates with humus content ($p = 0.00$) and also with exchangeable bases content ($p = 0.00$). This discrimination shows that systematization of arable grey forest soils was carried out mainly on the quantitative value of the humus content.

Classification matrix shows that arable light grey forest soils (Table 1) were mostly classified correctly (88.8%), whereas 39 arable horizons of grey forest soils were classified only correctly (57% of correct observations) and 69% of arable dark grey soils were classified correctly. Considering the greater error (up to 25%) the definitions of arable grey forest soils (that were diagnosed by NCC Land) classification function (FC) is not represented.

Table 1

Classification matrix of arable grey forest soils (row-observed classes, columns - predicted classes)

Soils	Percentage of correct	Number of samples of the arable horizon

	observations %	Arable light gray	Arable gray	Arable dark gray
Arable light grey forest soils	88,79	95	12	0
Arable grey forest soils	57,35	14	39	15
Arable dark grey forest soils	69,35	1	18	43
Total	74,68	110	69	58

The results of DF analysis (according to the virtual image of grey and dark grey soils) show the increase of reliable variables that allow to discriminate between the types. There is one significant DF, which correlates with humus content (p = 0.00), exchangeable bases content (p = 0.00) and clay content (p = 0.00). Classification matrix shows that agrogrey soils were correctly classified up to 97%, agrodark grey to 99% (Table 2).

Table 2

Classification matrix of agrogrey and agrodark grey soils (row-observed classes, columns - predicted classes)

Subtypes	Percentage of correct observations, %	Number of samples of the arable horizon	
		Agrogrey	Agrodark grey
Agrogrey	97,04	164	5
Agrodark grey	98,53	1	67
Total	97,47	165	72

FC, based on 237 data of arable horizons:

$S_1 = 1.88x_1 + 0.41x_2 + 1.16x_3 – 31.26$

$S_2 = 4.08x_1 + 0.67x_2 + 1.34x_3 – 54.55$

S_1 – agrogrey soils, S_2 – agrodark grey soils, x_1 - humus content in the arable horizon, x_2 – exchangeable bases content in the arable horizon, x_3 – clay content in the arable horizon.

Using these functions the definition error of agrogrey and agrodark grey soils of the Volga-Kama forest-steppe makes 3%. Thus, resulting functions of DF and FC may be used for the definition of new agrogrey and agrodark grey soils of the Volga-Kama forest-steppe.

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J11409-003

Chuzaeva N.V., Saldaeva E.Yu., Tsvetkova E.M., Vasenev E.A.

INFLUENCE OF ACCRETION CUTTING DIMENSION ON PHYSICAL CHRACTERISTICS OF BETULA PENDULA WOOD

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Abstract. The article is devoted to the study of the problem of influence of accretion cutting of different scale (15%, 30%, 40%) on physical characteristics of wood of European white birch.

Key words: wood moisture content, shrinkage of wood, wood swelling, density – absolute and basic, acoustic characteristics of wood (sound speed and acoustic resistance);

Introduction

Topicality. Deficit of high quality merchantable wood is one of the most topical issues of today. Influence of different factors on physical characteristics of wood species was studied by O.I. Poluboyarinov, B.N.Ugolev, S.A.Denisov and others [9, 12, 14]. It was found out that dimension of tending felling was one of the most important tool assuring formation of physical characteristics of wood.

Soft wood is mainly used in industrial production. Soft wood resources run low quickly enough. At the vast harvesting areas broadleaved forest takes the place of softwood forest. Hardwood may help to compensate deficit of softwood, in pulp and paper production in particular. Nowadays an interest to fast-growing broadleaved forests, mainly to Birch and Aspen forests (exploitable age - 40 - 60 years), grows. Birch is a valuable species, which plays an important role in formation of high-bonitet plantings and forests of future in the Middle Volga.

The area of Birch forests in Russia is about 80 mln. ha with total standing volume of industrial wood about 6 bln.m^3. They take the third place after larch and pine forests. In the area of mixed forests of the European part of Russia, Birch forests take the second place in forested area and timber volume. Timber volume yield of high-productive 50-year old Birch forests is 350 m^3/ha and more [15].

Forests of Mari El Republic belong to the zone of mixed coniferous-broad leaved forests. The total area of forestry fund lands of the region is 1276.9 ths.ha. The total standing volume at the forestry fund lands is 180.03 mln. m^3. The volume of Birch forest is 31.0% of total standing volume [16].

Thus, one of the most important forestry practice, directed to formation of high-productive Birch forests and obtaining of wood of high quality, are cleaning cuttings.

Goals and objectives. The main goal of the research is to study influence of accretion cutting of different scale (15%, 30% and 40%) on physical characteristics of European white birch. Such parameters as: moisture content, shrinkage, swelling, density and acoustic properties (sound speed and acoustic resistance) of European white birch were studied.

Methods and object of research. In order to achieve some results, a permanent inventory plot in Nolkinskoe forestry (allotment 9, planning quarter 61) in the branch of Volga State University of Technology “Scientific-Experimental Forestry” was set up in accordance with All-Union standard 56-69-93 [11]. The sample plot (total area – 2 ha) was set up in winter season 1970 – 1971 in birch forest of pyrogenic origin under the guidance of professor A.K. Denisov with participation of E.I.Uspenskiy, S.A.Denisov, A.V. Ivanov (members of the chair of Forestry). Birch forest grew at

the fire-site (fire took place in 1921) and it was not the object of tending felling till the start of the experiment, because the forest was located at the territory of special protection, withdrawn from the forest fund, till 1970. Accretion cutting of 15, 30 and 40% scale were carried out in this stand. At the time of trial establishment, the age of stand was 50 years, at the time of research it was 92 years (even-aged stand, forest site type – fresh subor, forest type - birch forest, bonitet -$1^{б}$).

Number of sample trees is 6, selection of trees is carried out in accordance with National State Standard 16483.6-80 [4].

Harvesting (preparation of logs) was conducted in accordance with National State Standard 16483.21-72* [3] and National State Standard 16483.0-89 [8]. Sampling was carried out by O.I.Poluboyarinov methods [12]. Wood moisture content was determined by the samples (size of samples was 20*20*30 mm) pursuant to National State Standard 16483.7-71 [2]. Studies of shrinkage and swelling of wood were carried out in accordance with National State Standard 16483.37-88 and National State Standard 16483.35-88 [6, 7]. Wood density was defined in accordance with National State Standard 16483.1-84 [5]. Sound speed (*C*) was measured by ultrasonic pulse method. Acoustic resistance (R) was calculated by the formula:

$$R=\rho C, \quad (1)$$

where ρ – material density, kg/m^3; *C* – sound speed , m/s.

Results discussion. Results of study of physical characteristics of European white birch are presented in Table1.

Absolute volume swelling of wood (α_{max}) is increase of irreducible water content in wood when keeping it in humid atmosphere or water, which is accompanied by increase of linear size and volume of wood. Thus, swelling of wood is an inverse to shrinkage phenomenon [14]. Mean values of absolute volume swelling of European white birch were 35.0 – 37.0%.

Table 1. Statistical parameters of physical characteristics of European white birch

Intensity of sampling	Statistical indicators	Physical characteristics						
		W, %	β_{max},%	α_{max},%	ρ_o, kg/m^3	$\rho_б$, kg/m^3	C, m/s	R, Pa· s/m
15%	Mean ± St. mistake	6.5±0.52	26±0.73	35±1.34	665±10.8	494±11.2	5978±64.1	40±0.8
	St.deviation	1.27	1.79	3.29	26	27	157	1,95
	t experiment	7.9	2.8	3.8	1.6	2.3	1.1	2.0
30%	Mean ± St.mistake	7.3±0.75	27±0.41	37±0.77	674±8.09	492±7.43	6051±93.0	43±1.2
	St. deviation	1.84	1.0	1.88	19.8	18.2	227	2.93
	t experiment	10.2	1.5	2.0	1.2	1.5	1.5	2.8
40%	Mean ± St. mistake	7.25±0.49	26±0.9	35±1.7	653±9.2	485±11.0	6043±65.5	40±0.64
	St. deviation	1.35	2.3	4.3	24.0	26.0	162	1.6
	t of experiment	7.2	3.5	4.7	1.4	2.1	1.1	1.6
Mean table values by B.N. Ugolev [14].		8-11%	11-17%	-	620 kg/m^3	520 kg/m^3	5530 m/s	29 Pa· s/m

Notice: W,% - wood moisture content; β_{max},%- absolute shrinkage of wood; α_{max},% - absolute volume swelling of wood; ρ_o, kg/m^3 – density of oven-dry wood; $\rho_б$, kg/m^3- basis density; C, m/s – sound speed in wood sample; R, Pa s/m – acoustic resistance.

Density (ρ) experiment samples of European white birch does also significantly differs from the given in [14] data and in the tables of standard reference data. Index of basis density (ρ_6) for European white birch is 520 kg/m^3, for oven-dry wood (ρ_0) – 620 kg/m ^{3}. Implementation of tending felling decreased basis density up to 485–492 kg/m^3, but it increased oven-dry wood to 653–674 kg/m^3. Influence of intensity of sampling on density of oven-dry wood is for certain between 30% and 40% variants, which is confirmed by Student criterion (t_{actual}=3.14)>($t_{standard}$=2,447).

Mean values of sound speed (C) in case of pitch oscillation by the data [1, 14] for Birch wood is 5530 m/s. In the samples the parameter varies from 5978 s/m to 6051 m/s, which indirectly indicates wood densiy.

In our research acoustic resistance (R) varied from 40 to 43 Pa·s/m. Study of data of acoustic resistance proves the conclusion about positive influence of tending felling on formation of timber with higher density. Intensity of sampling influences on acoustic resistance in all the aspects of the experiment.

Implementation of accretion cutting of different scale on physical characteristics of European white birch has an impact (5% level of significance) on such physical characteristics as: absolute volume shrinkage and absolute volume swelling of wood, density of oven-dry wood and acoustic resistance.

Conclusions:

Implementation of accretion cutting of different scale has an impact on physical characteristics of European white birch (5% level of significance). Such physical characteristics as absolute volume shrinkage and absolute volume swelling of wood, density of oven-dry wood and acoustic resistance are influenced.

Absolute volume shrinkage of wood of European white birch is within 26–27% which is explained by increase of adsorbed water in wood caused by better growth conditions after stands thinning by tending felling.

Mean values of absolute volume swelling of European white birch were 35.0 – 37.0%. At a site with 15% and 40% intensity of sampling, mean values of absolute volume swelling was 35%, at a site with 30% intensity of sampling – 37.0%.

Implementation of tending felling decreased basis density up to 485–492 kg/m^3 but density of oven-dry wood exceeded standard values [14]. It is 653–674 kg/m^3. Influence of intensity of sampling on density of oven-dry wood is for certain between 30% and 40% variants (confirmed by Student criterion (t_{actual}=3.14)>($t_{standard}$=2,447).

Mean values of sound speed (C) in case of pitch oscillation in samples varies from 5978 s/m to 6051 m/s, which indirectly indicates wood density.

The value of acoustic resistance is from 40 to 43 Pa·s/m. Study of data of acoustic resistance proves the conclusion about positive influence of tending felling on formation of timber with higher density. Intensity of sampling influences on acoustic resistance in all the aspects of the experiment.

Intensity of sampling had a significant influence on physical characteristics of wood of pyrogenic birch forests. The best physical characteristics were formed with 30% intensity of sampling.

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INFLUENCE OF SOYBEAN PLANT DENSITY ON THE DEVELOPMENT OF FUNGAL DISEASES

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Annotation. Based on many years of data are the results of studies on the impact of regulations on the development of soybean seeding fungal diseases (Septoria, Ascochyta-leaf spot). As a result of observations provided data that suggest that the optimal rate of sowing soybean in which conditions are favorable for plant growth and development, and which marked a low level of disease infestation is 600-800 thousand seeds per hectare. We also show the impact of regulations on the performance of seeding productivity.

Key words: soybean, the rate of seeding, pathogen, disease progression, disease spread, yield.

The aim of the study was to investigate the influence of stand density soybean plants on the development of fungal diseases.

Soybean acreage in Ukraine since 2001 and to date has increased by 15.1 times. The program of soybean production in Ukraine in 2017 is planned to expand its crops to 2 million hectares to increase production to 5 million tons [1]. Saturated rotation increases the threat of defeat of many diseases caused by fungi, bacteria and viruses [2, 3]. Diseases spoil seeds rarely stairs, inhibit plant growth and development [4]. The main damage from injury grain fungi is the loss of its mass and deterioration of quality indicators. Due to the strong development of the disease crops may die. Timely implementation of preventive measures makes it possible to prevent yield losses. Farming practices are already integrated protection providing prevention and protection of soybean pests. One such event is the right choice seeding rate, which determines the density of standing plants in crops.

Conditions and methods of research. Study was conducted during 2012-2013 in the field experiment's department of plant protection from pests and diseases NSC "Institute of Agriculture NAAS". Effect of Seeding rate for soybean disease development was studied in ripening varieties Ug-30. Soybeans were seeded in rules 400, 600, 800 thousand and 1 million seeds per hectare alike. Accounting infestation of plants was carried out according to conventional methods in the phase of flowering and maturing soybeans. The selection of sampling and determine the structure sheaves harvest was performed by the method of state strain testing of crops (1985). Direct harvesting performed accounting in sections harvest. Humidity seed weight of 1000 seeds, germination energy and germination were determined by ISO 4138-2002. Mathematical processing of the results was performed using the methods of variance and correlation analysis and statistical evaluation of the average, according to the procedure. The data were analyzed by the methods of mathematical statistics on a personal computer using the software package "Statistica-6".

Results. In 2012-2013 experiments, soybean crops were the most widespread fungal diseases are septoria and ascochyta-leaf spot. Observations showed that a significant impact on their development must stand density of plants (Table 1).

Most lesions soy these diseases were found in areas with high dense plants in crops (seed rate per 1 million/ha). In this embodiment, the number of plants affected by septoria in flowering phase was 28.2%, with the development of the disease – 6.5%, while in the crops of rules 400 and 600 thousand seeds per hectare infestation of plants was lower at 8.2-6.7%, and progression of the disease – by 2.4-1.1%, respectively.

Established the same trend of infestation of soybean plants ascochyta-leaf spot where the seeding rate by 1 million seeds per hectare spread of the disease was highest, and was 21.6% for the development of the disease – 5.0% (flowering stage) whereas in the seeding rate of 800 thousand/ha, the number of plants affected by ascochyta-leaf spot was lower by 1.6%, while growth – 0.4% at a rate of 600 thousand/ha – 6.3%, and growth – by 1.2% and at a rate of 400 thousand/ha – 13.0 and 2.8%, respectively.

Table 1

Infestation of soybean fungal diseases in different sowing (Experimental Farm "Chabany", Variety – Ug-30, the average for 2012-2013)

Option experiment	Flowering soybean		Maturation beans	
	affected plants,%	development of the disease,%	affected plants,%	development of the disease,%
Septoria				
400 thous./Ha	20.0	4.1	29.3	7.7
600 thous./Ha	21.5	5.4	39.3	9.6
800 thous/ha	27.0	6.0	46.9	11.0
1,000,000./Ha	28.2	6.5	51.9	14.8
NIR05	0.9	0.4	1.7	1.2
Ascochyta-leaf spot				
400 thous./Ha	8.6	2.2	28.6	6.4
600 thous./Ha	15.3	3.8	39.3	10.1
800 thous/ha	20.0	4.6	48.6	13.1
1,000,000./Ha	21.6	5.0	56.7	17.0
NIR_{05}	1.1	0.3	1.4	2.8

In the phase of ripening pods observed, the same trend spread of disease on soybean. We found that the lowest level of lesion of septoria (spread 29.3-39.3% for development – 7.7-9.6%) and ascochyta-leaf spot (spread 28.6-39.3% for development – 6.4-10.1%) was noted in areas where soybeans were seeded per rules 400 and 600 thousand seeds per hectare. By seeding rate of 1 million seeds per hectare, spread of disease was significantly higher and amounted to: septoria – 51.9% for development – 14.8%, ascochyta-leaf spot– 56.7% for development – 17.0%.

Thus, the studies found that the development of diseases that strike leaves of soybean greatly influenced by seeding rate. Optimal rules can be considered from 600 to 800 thousand seeds per hectare, where the degree of damage disease was at obtaining sufficient yields on indicators of disease infestation. This is because the thickened soy crops creates a microclimate that is favorable for disease development (high humidity, low aeration crops, etc.).

Analysis of harvest data showed that the thickened soy crops infestation of plant fungal diseases was highest, and structural parameters (number of pods and seeds per plant, weight of 1000 grains) were lower than the values obtained in a thinned condition (600 thousand/ha), respectively (4.6 and 0.4 pc., 1.24 g, Tab. 2). Greater yield was obtained by sowing soybean sowing quantity of 600-800 thousand seeds per hectare – 1.65 and 1.81 t/ha, respectively. This relatively low yield due to the low fertility of the soil (sod-podzolic sandy loam) which was founded research. Despite the fact that the number of indicators pods per plant, number of seeds per plant and weight of 1000 grains a variant of seeding rate of 400 thousand seeds per hectare were slightly higher compared with standards 600 and 800 thousand seeds, but due to the smaller number of plants per hectare their yield was lower.

Table 2

Effect of seeding rate on productivity
of soybean plants
(Variety Ug-30, Experimental Farm "Chabany", average 2012-2013)

Option experiment	Number of pods per plant, pcs.	Number of seeds per plant, pcs.	Weight of 1000 grains, g	Yield, t/ha
400 thous./Ha	20.7	42.4	138.52	1.16
600 thous./Ha	18.2	39.0	135.42	1.65
800 thous./ha	14.3	29.4	135.61	1.81
1,000000./ha	13.6	28.6	134.18	1.60
NIR_{05}	0.6	1.1	0.5	0.1

Conclusions

1. The development of fungal diseases of soybean (septoria, ascochyta-leaf spot) significant impact has densely and standing plants. Crop soybean width between 45 cm and seed number rate of 600-800 thousand seeds per hectare contributed decreasing infestation of diseases of septoria – 8.2-22.6%, ascochyta-leaf spot– 13.0-28.1%.

2. Number of productive culture these standards sowing comparatively with thickened crops (1 million/ha) which created microclimate more favorable for disease development was greater by 0.05 – 0.21 t/ha.

3. Liquefied crops of soybean seeding rate seeds (400 thousand/ha) have insufficient number of plants to provide a yield.

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COMPARATIVE EVALUATION OF PROCESS PARAMETERS GRAIN QUALITY OF SPRING BARLEY GROWN UNDER DIFFERENT FARMING SYSTEMS AND BASIC TILLAGE

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Abstract. This paper presents the results of research on the impact of farming systems and soil tillage on technological quality parameters of spring barley.

Key words: barley, grain quality, farming systems, soil tillage systems.

Increased production and harvesting of grains of different cultures – a necessary condition for normal consumption of food, supplies seed for sowing purposes, industry – raw materials, livestock – feed state reserves, to further improve and create well-being of the population and food security.

Protection factors are dominant in growing crops, although the use of these crops is quite small: in modern agriculture agrometeorological resources are used only by 40–60 % [5]. The value of this level is quite dependent on the development of agriculture – in the case of extensive driving his share of influence of soil and climatic conditions, increasing to 60 %, and intensive agriculture – three times less [2]. This situation requires the development of effective measures of regulation receiving crop production and quality.

The purpose of today's farming systems is to provide high-performance, low-cost, environmentally-sound production planned quantity and quality of agricultural products. Scientific and practical basis for achieving this goal is a system of agriculture that can provide stability agrolandscapes priority means biologization in conjunction with adaptive technologies cultivation [1, 3, 4].

The increase cropping intensity requires extensive research quality and safety of plant products. Therefore, research on the impact of farming systems and soil tillage on grain quality of spring barley, which contribute to the formation of high quality

raw materials for use in cereals, feed and industrial purposes is fairly urgent task today.

Material and methods research. The study was conducted at the laboratories of the Department of Technology of storage, processing and product standardization Ya. prof. BV Lesik National University of Life and Environmental Sciences of Ukraine.

We investigated the grain yield of spring barley 2009–2013, bred by industry (control), ecological, biological farming systems and a conventional+minimum+harrowing (control), minimum tillage, conventional+ minimum tillage, harrowing surface tillage on test plots stationary experiment the Department of Agriculture and herbology in RP NUBiP Ukraine "Ahronomichna Experiment Station."

Investigated different farming systems of resource support: industrial (control) – the preferred use of agrochemicals industry for restoring soil fertility introduction on 1 hectare of crop rotation area 12 tons of manure, 300 kg of NPK fertilizers and intensive use of pesticides to protect crops from pests, ecological – priority use for the fertility of the soil organic fertilizers with the introduction on 1 hectare of crop rotation area 24 tons of organic (manure 12 t 6 t of the non-tradables yield 6 tons weight green manure crop) and 150 kg of NPK fertilizer, seed processing complex biologics, chemical preparations for the criterion environmental and economic threshold of harmful organisms, biological – use only natural resources – 24 t / ha of organic matter for soil fertility without making industrial agricultural chemicals, use of complex biological product for seed treatment and biological crop protection tools.

These options are explored resource providing background on four different soil tillage in crop rotation. Conventional+minimum+harrowing (control) combined rotation by holding six tillage two surface disc harrow cultivation under winter wheat after peas and corn silage and minimum tillage cultivation in barley after sugar beet. Option minimum tillage was performed by rotation under all cultures minimum loosening, other than those of winter wheat fields where the soil was treated with disc harrows. In an conventional+ minimum tillage by rotation was performed under two

tillage sugar beet bunk plow five minimum loosening and disking soil in these fields under winter wheat. Variant harrowing surface tillage cultivation in crop rotation was carried out to a depth of 8–10 cm disc harrows under all cultures.

Indicators of the quality of grain of spring barley were determined by conventional methods, which are used to assess the quality of grain and its products.

Results. Depending on the parameters of quality barley is used for food and feed purposes, the production of malting and brewing. For the production of malt and brewing prerequisite is high values of capacity for germination and viability within 92–95 %. Also, by using a special grain brewing is reduced protein content in the range of 9 to 11 % of absolutely dry matter. The standard malting barley assumed its harvesting in areas where growing conditions are favorable for the formation of the endosperm of the grain with high starch content.

Research has found that the grain of spring barley grown under all farming systems and soil tillage meets the requirements that are put to use in food and feed purposes (Table 1).

As can be seen from Table 1 only ecological farming system for all primary tillage systems ensures quality of spring barley grain protein content of 11.5 % and lower performance capacity for germination and viability of 92–97 %. This expands the purpose of the grains and allow its use for the production of malting and brewing. The 1 st class corresponds grain obtained by conventional+minimum+harrowing and conventional+minimum tillage and 2nd – obtained by minimum tillage and harrowing surface tillage.

Table 1

Comparative evaluation of grain quality of spring barley under different farming systems and soil tillage, 2009–2013 years

Variant		Indicators			
Farming systems	Soil tillage systems	grain unit, g/l	protein, %	ability to germinate, %	viability %

Industry (control)	Conventional+minimum+ harrowing tillage (control)	639	13.6	98	99
	Minimum tillage	627	13.0	94	95
	± to control	-12	-0,6	-4	-4
	Conventional+ minimum tillage	633	13.5	98	99
	± to control	-6	-0,1	0	0
	Harrowing surface tillage	629	12.9	93	95
	± to control	-10	-0,7	-5	-4
Ecological	Conventional+minimum+ harrowing tillage (control)	632	11.3	97	97
	± to control	-7	-2,3	-1	-2
	Minimum tillage	617	10.7	93	96
	± to control	-22	-2.9	-5	-3
	Conventional+ minimum tillage	630	11.1	95	96
	± to control	-9	-2.5	-3	-3
	Harrowing surface tillage	621	10.7	92	95
	± to control	-18	-2.9	-6	-4
Biological	Conventional+minimum+ harrowing (control)	628	10.8	92	95
	± to control	-11	-2.8	-6	-4
	Minimum tillage	616	10,2	90	91
	± to control	-23	-3.4	-8	-8
	Conventional+ minimum tillage	625	10.8	92	93
	± to control	-14	-2.8	-6	-6
	Harrowing surface tillage	613	10.2	89	91
	± to control	-26	-3.4	-9	-8

NIR_{05} (in absolute values)	8	1.3	3	3

Conclusions:

1. Crop of spring barley grown for industrial, ecological and biological farming systems and different soil tillage systems meet the requirements that are put to use in food and feed uses.

2. For spring barley grain quality and different purpose to apply ecological system of farming.

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SELECTION OF BEETROOTS FOR DRYING

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Abstract. The authors present the results of studying the efficiency of the dry beetroot production, which has been grown up in conditions Ukraine's Forest-steppe,

depending on a variety. An complex estimation of fresh and dried products of 5 different varieties and hybrids of beetroot for the content of the basic biochemical, biometric and technological parameters. Select the most suitable for drying.

Key words: beetroot, varieties, roots, quality, biochemical, technological parameters, drying

Introduction. Beetroot for their flavoring and medicinal properties occupies a leading position among the vegetables. Area under this crop in Ukraine in recent years remains at 40 hectares [1,3]. His roots remain for a long time and are used for different types of processing. Dried products table beet is widely used for cooking soups, so research the suitability of different varieties to this method of processing is important [5].

Material and methods research. The study was conducted during 2011–2013 years in National University of Life and Environmental Sciences of Ukraine. For experiments selected 5 varieties and hybrids recommended for cultivation in the conditions of Ukraine's Forest-steppe [2]. Standards were determined variety of domestic grade Nosovskii ploskui, used Ukrainian.

Beetroot grown in the experimental field NUBiP Ukraine, which placed in the northern part Forest-steppe of Ukraine. Biochemical, commodity and organoleptic tests were performed in laboratory of storage, processing and product standardization Ya. prof. B.V. Lesyka by the generally accepted methods [4]. To use dryer drying "Sadochok-2M" (TU 23061103.001-98), which refers to convective air dryer chamber type.

Results of research. Results marketable beetroot assessment shown in Table. 1.

Table 1

Biometric, biochemical, commodity and organoleptic parameters assortment of beetroots, average of the years 2011-2013

Name of the variety	Diameter of commo-dity roots,		Contents in roots		Marke-tability, %	Tasting estimate
	g	S.F.	dry matter, %	ascorbic acid, mg/100 g		

Nosovskii ploskui (control)	114±10	1,20	12,8	12,2	91,8	19,8
Bordo kharkivs'kui	106±18	1,40	12,0	8,4	78,3	18,2
Detroit F_1	84±6	1,19	10,7	15,2	89,4	19,7
Egypets'kui ploskui	110±18	1,40	9,6	10,2	85,0	17,2
Cylindra	62±8	1,25	14,9	13,6	76,4	19,6

For biometric parameters and commodity assortment prevailed among the studied sort Nosovskii ploskui (control), the roots of which were most severe (374,9 g) had the greatest transverse diameter (114 ± 10 mm) were most stable in this indicator and form the most standard roots (91,8%).

Suitability of roots for drying significantly depends on the contents of the main biochemical parameters. The content of dry matter of roots variety Cylindra substantially prevailed control and other experimental variations. Most ascorbic acid accumulated root varieties Detroit F_1 – 15,2 mg / 100 g. The highest marketability established in root sort Nosovskii ploskui (91,8), and hybrids Detroit F_1 (89,4 %).

For organoleptic characteristics were best roots sort Nosovskii ploskui and hybrids Detroit F_1. Established direct correlation interrelation between the taste of roots and amounts of sugar ($r = 0,72 \pm 0,13$).

During the study established the most important technological characteristics of the studied varieties of roots to dry (Table. 2).

Table 2

Technological parameters assortment of beetroot,

average of the years 2011-2013

Name of the variety	Quantity of waste, %	Yield dry products from purified material, %				Yield dry products from unprepared material, %	Quantity kg of fresh material to produce 1 kg of dry
		2011	2012	2013	середнє		
Nosovskii ploskui (control)	13,0	13,8	14,4	14,0	14,1	12,2	8,2
Bordo kharkivs'kui	24,8	12,5	13,1	12,9	12,8	9,6	10,4
Detroit F_1	16,0	12,0	12,5	12,8	12,5	10,2	9,8
Egypets'kui	23,2	11,4	11,2	10,8	11,2	8,7	11,5

ploskui							
Cylindra	15,2	16,0	16,8	16,2	16,3	13,8	7,2
NIR* $_{05}$	2,8-3,2	1,5	1,7	1,3			

*the least essential difference

Significant difference between the experimental beetroot was by the quantity of waste in preparation for drying. Most of them are established in the roots of sorts Bordo kharkivs'kui and Egypets'kui ploskui – 24,8 and 23,2%, respectively. Least of all of waste was in control of a variety Nosovskii ploskui (control) – 13,0 %, which is characterized by the highest root marketability and uniformity of diameter.

The largest yield of dry products is installed in a sort Cylindra – 16,3 % on average over three years. According to this indicator established essential difference compared with the control in all the years of research.

To produce 1 kg of dry of products had an average to remake 7,2-11,5 kg of fresh root (including in the waste). Least of all they is spent if used for drying grade Cylindra – 7,2 kg, which is 12,2 % less than the control.

Quite effectively used for this type of processing roots of the variety Nosovskii ploskui (control). Considering least amount of waste for the production of dry of products had to to remake 8.2 kg of fresh roots.

As the dried beet are eaten only after cooking, the importance of having their culinary qualities that primarily depends on the contents of the main biochemical parameters (Table 3).

Table 3

Biochemical composition and tasting score dried products of beetroot depending on variety, average of the years 2011-2013

Name of the variety	The content of dry of products, %					Ascorbic acid, mg/100 g	Tasting estimate*
	dry matter	titrated acids	mono-saccha-rides	suc-rose	total		
Nosovskii ploskui (control)	86,9	0,67	3,8	62,6	66,4	22,4	8,4
Bordo kharkivs'kui	86,7	0,58	3,7	45,6	49,3	14,2	7,4
Detroit F_1	86,0	0,50	6,5	45,6	52,1	20,3	8,2
Egypets'kui ploskui	87,4	0,61	7,9	39,4	47,3	14,6	7,0

Cylindra	87,3	0,66	6,5	50,3	56,8	18,2	8,2

*9-point scale

Dry beet production is characterized by a high content of dry matter (86-87 %) and sugars (47,3-66,4%). Compared with fresh raw amount them increased at 9,10 times.

The content of dry matter in the dry of products essential difference between the variants have been identified. The largest amount of sugars in the samples was controlling variant – 66,4%, hybrids Detroit (52,1 %) and sort Cylindra (56,8 %).

Sugar content affect the taste of products. The highest scores during tasting the dry product got varieties Nosovskii ploskui (control), hybrids Detroit and sort Cylindra – 8,4 and 8,2 points. Production of have bright evenly color, pleasant characteristic aroma and taste, elastic consistency.

Dry beet production characterized by a high biological value – vitamin C content varies 12,3-18,4 mg% and is dominated by fresh produce. But after terms of Initial raw materials, it was found that during drying loss of this element significant and range between 65-74%. The smallest loss of vitamin C during drying established roots in the variety Nosovskii ploskui (control) and hybrid Detroit F_1.

Thus, for complex parameters defined in the fresh and dried products beetroot were most suitable for drying roots sorts Nosovskii ploskui (control) and Cylindra.

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SUITABILITY GRAIN OF WINTER WHEAT SPELT FOR BAKING AND FEED PURPOSES

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Abstract. Technological quality and overall nutrient of purified and unpurified grains of wheat spelt to use for baking and feed purposes were investigated. Established that spelt grain has a high value feed units and it is therefore may be highly fodder for animals. Bread produced from spelt flour had good mark that allow use it for produce high nutrient bread of good quality.

Key words: grain of winter wheat spelt, nutritive, technological indicators of quality, quality of bread, bakery and feed purposes.

Introduction. Spelt is undemanding, winter-hardy species of wheat which is known since ancient times. It was common in Europe and Asia is mentioned in the treatises of ancient Rome and medieval monks. Humanity millennium fed these grains and still remains unknown causes in which he was forgotten for many years.

As spelt almost perfect combination necessary for the human body vitamins, minerals, micronutrients, protein, fats and carbohydrates. Spelt richer than ordinary wheat for protein unsaturated fatty acids and cellulose. It contains special carbohydrate solution – mycopolisaccharides that can strengthen the immune system. Useful substances contained in spelled had high solubility, so they were easily and quickly absorbed by the body [1-3, 5-6].

Increased attention to spelt in many European countries over the last decade due to many reasons including low-suitability for agriculture was very popular in many

countries and even some nutritional and technological advantages it can in some cases to press traditionally dominant soft wheat. Grain spelt have typical high protein content in grain (more than 21%). Flour obtained from grain of wheat suitable for the manufacture of the finest quality confectionery products [2, 6].

The negative economic spelt qualities include pretty rough floral tape to snug against the grain and cover it. Such morphological feature complicates processes thrashing out grain from ears [3].

Materials and methods research. For studies were taken grain of winter wheat spelt variety Zorya Ukraine nurtured by the standard for the right-bank forest-steppe Ukraine cultivation techniques of cultivation: purified (free from flower films) and do not of purified (with film). Spending identifying key process Indexes quality of grain spelt carry out according to state standards in laboratory department of storage, processing and standardization of plant products named after prof. B.V. Lesik and Ukrainian Laboratory of Quality and Safety of Agricultural Products of National University of Life and Environmental Sciences of Ukraine. Total dietary 1 kg grain of spelt was calculated. Also by baking quality of the grain spelt as compared with grain wheat and spelt soft and mixture (1:1) produced by unleavened dough method laboratory trial batch of dough under intensive methods Ukrainian Institute examination of plant varieties [4].

Results of researchers. The first stage of our research was to study the basic biochemical parameters purified and unpurified grain of spelt which led to a number of conclusions on the use of data samples of grain for food and feed purposes (Table 1).

Table 1.

Biochemical parameters of purified and unpurified grains of wheat spelt

Name of indexes	Purified grains	Unpurified grains
Humidity,%	10.0	9.7
Crude protein,%	20.4	15.3
Crude fat, %	4.43	3.46
Fiber, %	2.7	13.6

Starch,%	60.1	35.6
Ash,%	1.7	1.7
Nitrogen by Kjeldahl method	22.3	–

Refined grain spelt characterized primarily high in nitrogen (protein) – 22.3 %. The content of crude protein in the unrefined grains are also quite high – 15.3 %. Simultaneously, the crude grain compared with refined spelt almost half the starch content – 35.6 % against 60.1 % in purified.

Ash content of grain spelt is average with which grain is suitable for the manufacture of flour.

For recommending spelt grain for feed purposes to calculate its nutritional value. And so as a grain of spelt difficult to separate from the films, it is important to compare the feeding value of crude and refined grains (Tables 2 and 3).

Table 2.

Calculation of total dietary 1 kg of purified grain of wheat spelt

Nutrients	Protein (P)	Fat (F)	Fiber (Fb)	Nitrogen-free extractive substances (NfES)
Contents crude indicators, g	204	44.3	27	707.7
Coefficient of digestibility	0.70	0.90	0.33	0.92
Content of digestible nutrients, g	142.8	39.87	8.91	651.08
Indicators of productivity, g	1.57	3.18	1.67	1.67
General productive action, g. f.u.	224.19	126.79	14.88	1087.30
Sum – 1453.16				

Nitrogen-free extractive substances – is no nitrogenous extractives which is determined by the formula:

NfES = 1000 – (P+F+A+Fb)

NfES = 1000 – (204 + 44.3 + 17 (ash) + 27) = 1000–293.30 = 707.7 (g) To express the parameters P, F, A, Fb in grams per kg. Should value their mass fraction multiplied by 10.

Expected productive force on 1 kg of grain multiplied by a factor of usefulness and determine nutrient: 1453.16 * 0.95 = 1380.50 g or 1.38 f. u.

NfES = 1000 – (153 +34.6+17+136) = 659.40 (g)

Expected productive force on 1 kg of grain multiplied by a factor of usefulness and determine nutrient: 1355.22 * 0.95 = 1287.46 g or 1.28 f. u

Table 3.

Calculation of total dietary 1 kg of no purified wheat spelt

Nutrients	Protein (P)	Fat (F)	Fiber (Fb)	Nitrogen-free extractive substances (NfES)
Contents of crude indicators, g	153	34.6	136	659.40
Coefficient of digestibility	0.70	0.90	0.33	0.92
Content of digestible nutrients, g	107.1	31.14	44.88	606.65
Indicators of productivity action, g	1.57	3.18	1.67	1.67
General productive action, g f. u.	168.14	99.02	74.95	1013.11
Sum – 1355.22				

Thus, grain spelled as refined and crude way has a high nutritional value, expressed significant fodder units. In particular, refined grains 1.38 and crude 1.28 f. u., which is a little difference. For comparison, soft wheat is characterized in average 1.18 feed units

Therefore, we can conclude that as refined and Untreated grain spelt is a highly fodder for animals. The use for feeding purposes crude grain spelt reduces cost of post harvest handling and simultaneously reduces the cost of the food.

The literature emphasizes the use of spelt grain in bread baking and for making confectionery. Therefore, our next task was to determine the properties of grain spelt flour and baking quality compared to soft wheat (Table 4, 5)

Table 4.

Technological parameters as refined grains spelt that affect the flour and baking properties

Name of the indexes	Humidity	Grain-unit	Mass of 1000 grains	Vit-reous	Quantity of gluten	Quality of gluten	Falling number
Value of indexes	13.3 %	665 g/l	41.7 g	66 %	49.5 g	102.5 u. a.	266 s

To produce flour weighty importance grain unit and weight of 1000 grains. For more promise than corn, the higher yield of flour. In grain spelt situ mass index is quite low – 665 g/l and a characteristic grain in wheat is low – grain unit. Simultaneously, weight of 1000 grains is spelt averages for wheat (41.7 g) and a corn flour is suitable for purpose.

The high rate vitreous grain spelt out 66 % provide high-quality flour of smaller particles. The sample studied grain spelt also had a high gluten content – 49.5 g, while low quality – 102.5 u. a. With so many gluten-free bread available high volume, but due to the quality of the dough may be blurred and reduce the amount of bread.

Index falling number 266 s has an average grain α-amylase activity that is positive and relatively high quality starch grain spelt that during the preparation of dough and bread create a stable "frame" and high volume.
A direct method of determining qualities is baking cakes laboratory test that we conducted on grain spelt flour and wheat mixture (1:1) and spelt soft bread to assess options studied (Table 5, Figure 1, 2).

Describing the resulting bread is worth noting a larger volume of grain spelt flour obtained from 650 (cm^3) compared to soft wheat (610 cm^3). In terms of

appearance and pulp noted a higher quality bread in the bread produced from wheat flour mix with a little lower and still lower with spelt flour.

Table 5.

The quality of bread from flour of different types

Flour of wheat grain of different kinds	Volume of bread,		Qualitative features, balla							Overall bakery score, mark
			Appearance			Porosity	Elasticity	Color of crumb	Taste and smell	
	cm^3	mark	Surface	Form	Color of crust					
Spelt	650	7	7	7	9	6	6	5	7	6.8
The soft	610	6	8	7	8	8	8	6	9	7.5
A mixture of spelt and soft (1:1)	610	6	7	7	8	7	7	5	9	7.0

1 2 3

Figure. 1. Bread from wheat flour various species (appearance): 1– mixture of spelt and soft; 2 – soft; 3 – spelt.

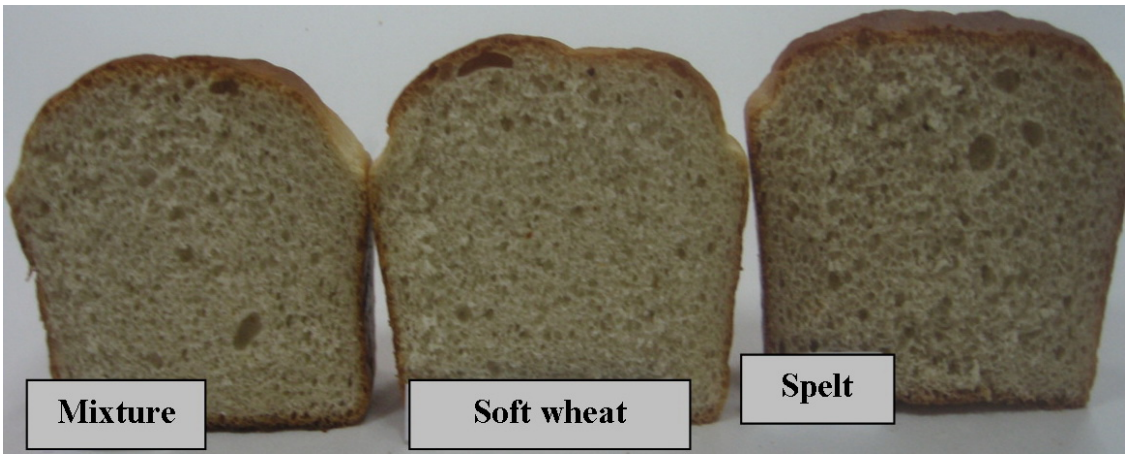

Figure. 2. Bread from wheat flour various types (cross-section).

Conclusions. Spelt wheat is characterized by good biochemical parameters: purified grain had protein – 21 %, starch – 60 % ash – 1.7 % but unpurified grain containing crude protein – 15.3 %.

Spelt grain has a high nutritional value: purified grain – 1.38 and unpurified grain – 1.28 f. u. Consequently, grain spelt is a highly fodder for animals and the use of crude grain significantly reduces the costs of post-harvest handling and also reduces the cost of the food.

Grain spelt characterized as low grain unit. At the same time, it has a high vitreous (66 %) and gluten content (49.5 g) and low quality of gluten (102.5 u. a.). Index falling number 266 s characterizes the quality of starch grain spelt. Bread produced from flour was spelt overall assessment baking – 6.8 mark and score well characterized, allowing the use spelt flour for the production of a highly good quality bread.

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J11409-008

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TECHNOLOGICAL EFFECTIVESS GRAIN OF WINTER WHEAT DEPEND ON FACTORS OF GROWING AND DURATION OF STORAGE

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Abstract. The influence forecrop, farming systems and duration of storage on the vitreous of winter wheat varieties Poliska 90 was established. A statistically significant effect on the change in vitreous all the factors with greatest influence on the farming systems.

Key words: winter wheat, vitreous, growing factors, duration of storage.

Introduction. A harvest and quality of grain is formed under act of factors external environment and agrotechnical receptions: to selection of predecessors, systems soil cultivation and preseed till of soil, top-dressing and use of pesticides. Storage of grain, being the last of peat-time in his production, substantially influences on quality of the got products. This is due to the fact that the grain is constantly occurring physical, chemical and biological processes that may lead to improvement or deterioration of grain quality [1–3, 6].

Essential to the processing of grains flour is its consistency. The higher vitreous, the more you can get grits from grains, and further it provides a higher yield of high

grades of flour. Preliminary study of the effect of shelf life for vitreous grains indicate that vitreous generally an indicator of stable and changes that were recorded are quantitatively small. At six months of wheat going to strengthen the consistency, expressed quantitatively improving your vitreous and explains the mutual influence of protein and starchy substances [1, 5].

Materials and Methods. The studies was conducted during the 2009–2013 with using winter wheat variety Poliska 90 grown after perennial grasses, peas and maiz which used on silage by intensive, ecological and biological farming systems. Grain stored in a normal granary and evaluated its quality in the laboratory of Department of storage, processing and standardization of plant products after name prof. B.V. Lesika of National University of Life and Environmental Sciences of Ukraine. Quality of grain according of research program defined before storage samples of grain (control) and after 1, 3, 6, 9 and 12 months of storage. Vitreous of grain determined respectively GOST 10987–76.

Results. The best adaptability , ie the ability to give a good yield and whole grains, and high grade flour by processing small grain produced after the precursor grasses (59–65 % vitreous) worst seed – after corn silage (35–48 %). The highest vitreous little grain produced by industrial farming systems, the lowest – in biological systems than all its predecessors (fig. 1).

During long-term storage processes going on in the grain grown after peas vitreous influenced by increasing the rate after the first month of storage at 4 % for the industrial system of agriculture, 10 % for environmental and biological farming systems and after the sixth month for 11 and 16 % accordingly.

For biological farming systems in terms of grain vitreous passed with second class (40 %) in the first (50–56 %). For further storage units vitreous slightly decreased. At the end of storage compared with the sixth month of storage of grain grown by industrial farming system decreasing vitreous within the error of the experiment (5 %) and environmental reduction was 6 %. Simultaneously, the grain produced by a biological system after the end of pea storage vitreous reduced by 8 % and was considered to be 2 class quality.

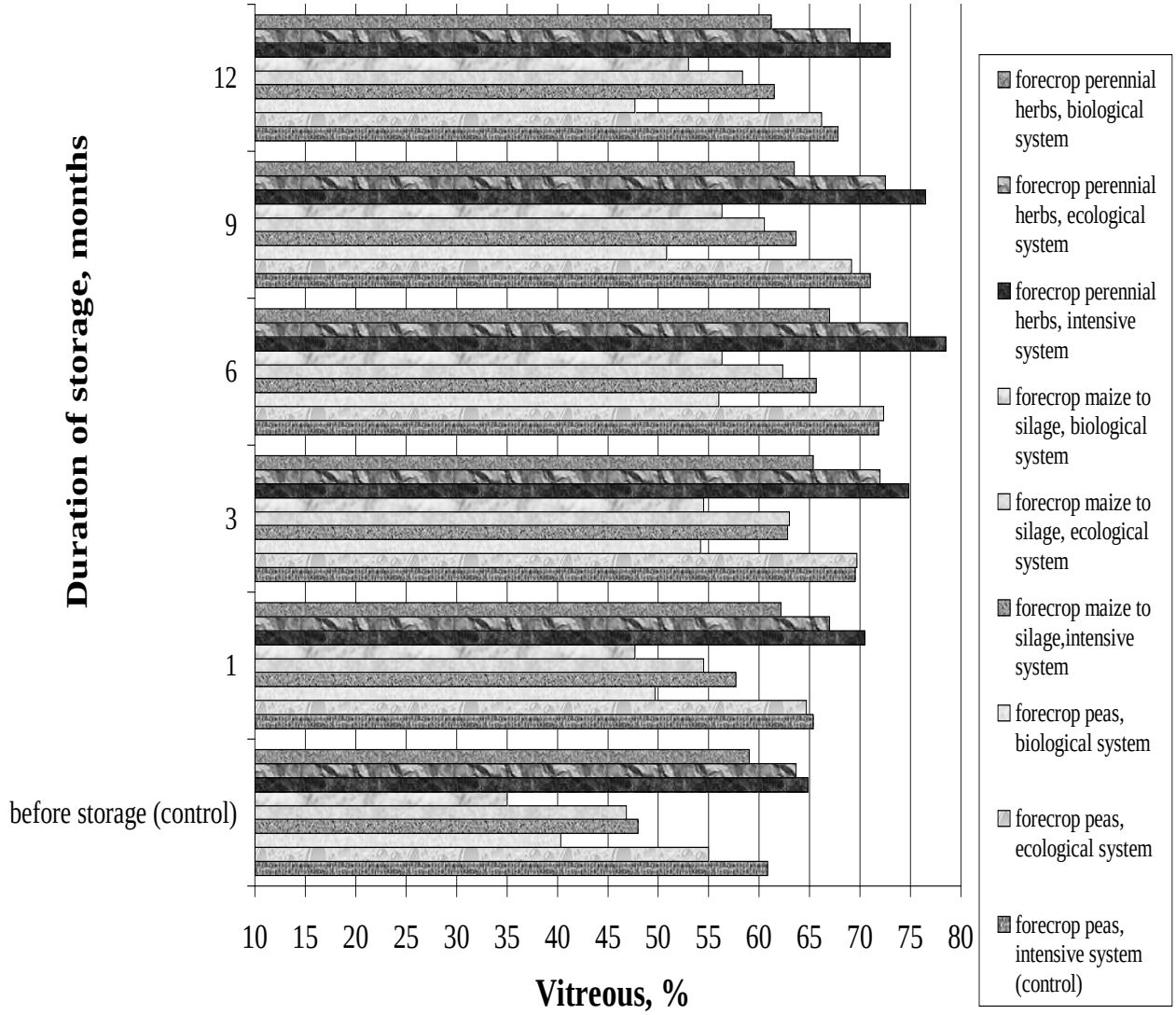

Fig. 1. Dynamics vitreous indicator of winter wheat grown under different farming systems and predecessors during storage (2009–2013)

Crop grown after corn, with a low initial values vitreous after the first month of storage significantly improved consistency, the rate increased by 8–13 %, and after six months of storage Vitreuesness increased by 16–21% compared with the original data. Thus again increased klassnost grain: with 2nd class 1st moved grain produced by industrial and ecological farming systems after the first month of storage; gradually from 3 to 2 after the first month of storage and 2 in 1st after the third month passed grain produced by a biological system. At the end of storage slight changes occurred vitreous grain grown after all the studied farming systems remain in the same class that have been achieved during the post–harvest ripening.

High figure vitreous throughout the storage period was characterized by grain produced after perennial grasses (average 59–79 %): for all variants of farming systems and throughout the period of storage of grain related to 1st class quality, vitreous changes during storage were within error of the experiment (5%).

Statistical mathematical treatment of the dynamics vitreous winter wheat during storage identified statistically significant effect on all studied parameters. Maximum effect on the studied parameters change during storage were farming systems, especially after peas (F_{calc} = 243.15 > F_{crit} = 4.10) slightly smaller effect was after perennial grasses (F_{calc} = 83.55 > F_{crit} = 4.10) and corn silage (F_{calc} = 64.15 > F_{crit} = 4.10). Maximum shelf life impact on the dynamics vitreous detected after predecessor corn (F_{calc}= 62.78 > F_{crit} = 3.33), somewhat less after perennial grasses and peas (F_{calc} = 32.92–32.68 > F_{crit} = 3.33). The highest impact predecessor studied parameters were observed by industrial farming systems (F_{calc} = 147.79 > F_{crit} = 4.10), somewhat less than the ecological and biological systems (F_{calc} = 31.50–95.45 > F_{crit} = 4.10).

Vitreous is caused by the presence of protein – not enough it does not create a dense texture, protein – starch complex, which in the determination on the device shows a glassy "transparent" for the penetration of light texture unlike floury, which absorbs light.

Determined the correlation between the number of gluten and vitreous studied variants winter wheat. It found a close relationship between the amount the direct of gluten and vitreous: correlation coefficient after perennial grasses was 0.87 (strong relationship) after peas – 0.96 (very strong relationship) and the lowest was 0.78 after corn (strong relationship). Regarding farming systems, the highest ratio in the ecological system – somewhat less than 0.93 of biological systems – 0.86 and even less connection for industrial systems – 0.84.

Conclusions

1. The highest vitreous throughout the storage period was corn grown after perennial grasses (within 59–79 %) and was considered to be 1 class quality, vitreous changes during storage were within the error of the experiment (5 %). In a period of

three to twelve months of storage vitreous grew corn grown after peas (at 4–16 %) and corn (at 9–21 %), which contributed to the improvement of grain klassnosti to 1 class (except for corn grown after peas biological system that at the end of storage was considered to be 2 class quality).

2. Statistical treatment of the dynamics vitreous wheat during storage has identified a significant effect on the studied parameters of all the factors with the greatest impact on farming systems peas (F_{calc}= 243.15 > F_{crit} = 4.10), the maximum period of storage after its predecessor corn (F_{calc} = 62.78 > F_{crit} = 3.33) and the highest predecessors for industrial farming systems (F_{calc} = 147.79 > F_{crit} = 4.10).

3. Was a direct link between the strong the number gluten and of vitreous (average 0.84–0.93).

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SUITABILITY POTATO VARIETIES FOR LONG TERM STORAGE

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Annotation. Influence of potato variety on keeping quality was presented in the article.

Key words: potato tubers, variety, term of storage.

Introduction. Potatoes are universal culture, which is used for food, fodder, technical needs and more. About 20 million tons of tubers potato annually was grown in Ukraine. Season consumption of fresh directly from the field rather short is only 3.0-3.5 months, almost all the crops should be stored for a certain period. We have to keep fresh potatoes food and feed purpose within 8-9 but seed potatoes up to 7-8 months. Thus, the seasonal of potatoes storage is three times more then period of its cultivation. Therefore, it is of great value, properly organized storage of potatoes, which allows for the population and the food industry with high-quality potatoes and farms - seed.

As you know, survival of potatoes depends on many factors. There are growing conditions, climatic conditions, the possibility of the best ways and regimes of storage. However, a critical value has variety. In recent years, the fields of Ukraine, near the studied varieties grown massively new and keeping quality are studied insufficiently or not at all understood.

Research carry out using varieties medium term ripening grown in the forest-steppe zone of Ukraine: Alvar, Fantasy, Satin, Labadiya, Ramos. The aim of our research was the selection by the complex of biological, technological and organoleptic parameters potato varieties suitable for long term storage.

The studied varieties kept in conditions of deepening basement storage for installing dynamic changes of the studied parameters at regular intervals (2, 4, 8

months) and at the end of storage was performed follow-up examinations of accounting samples.

State of preservation of potato varieties research after storage was evaluated by weight grids before and after storage (natural losses), the number of tubers affected by disease, rotten, sprouted, flabby, tubers mechanical damage. Based on these data and calculated the total loss of healthy tubers. The research results are presented in Table 1.

Table 1.

Keeping quality of potato tubers during storage

Variety	Content tubers ... months of storage,%							
	flabby				germinated			
	2	4	6	8	2	4	6	8
Fantasy (control)	1,5	3,2	5,9	6,2	0,6	1,2	5,1	14,2
Alvar	2,1	4,2	7,3	8,1	1,8	2,4	5,2	11,4
Satin	2,2	3,8	6,2	7,9	0,8	2,2	6,3	10,7
Labadiya	1,8	4,1	6,4	7,8	0,7	1,9	5,8	11,6
Ramos	3,1	4,3	7,1	9,3	1,7	2	6,2	13,1

Keeping quality of potato tubers primarily determined by genetic characteristics. Most flabby tubers after 2 months of storage were observed in a variety Ramos – 3 %, while the smallest number of them were in grade fantasy –1.5 %. A similar trend was prominent after 4 months of storage. After 8 months of storage increased the number of flabby tubers, but most of them had seen in grades Ramos (9.3 %) and Alvar (8.1 %).

During storage there was sprouting tubers. So, after 2 months of storage in grades Ramos, Alvar had 1% sprouted tubers but the Fantasy has only 0.6 %. Most sprouted tubers after 8 months of storage was observed in Fantasy - 14.2 % and Ramos - 13.1 % but in Satin – 10.7 %.

The best keeping quality during storage of tubers were characterized by a variety Fantasy, and appeared in the preservation of the worst Ramos.

If you store the tubers in a normal store without artificial cooling, loss of bubbles are given in Table. 2.

Prior to the largest storage tubers characterized by variety Labadiya - 99.4 grams (1.0 gram more than the control). During the period of storage tubers varieties of weight loss ranged from 8.0 to 12.0%, which is higher compared to the standard rates of 1.1 - 5.1 %, respectively. Least for the period of storage in losing weight tubers class Satin - 7.3 g or 8.0 % compared with the initial weight. As seen from Table 2 for the eight months of storage the largest mass loss recorded in samples of tubers varieties Ramos - 12.0 %, up 5.1 % compared with the control. Thus, the weight loss of tubers during storage period did not depend on their mass and defined varietal characteristics.

Table 2.

Mass loss of potato tubers of different varieties during storage, %

Variety	Average weight tubers before storage, g	Weight of tubers (g) through months of storage ...				Loss of weight *	
		2	4	6	8	г	%
Fantasy (control)	98,4	97,8	96,2	93,6	89,2	9,2	9,3
Alvar	72,4	71,3	70	67,4	65,1	7,3	10,1
Satin	91,2	89,9	89,5	86,1	83,9	7,3	8,0
Labadiya	99,4	98,1	96,8	93,4	91,2	8,2	8,2
Ramos	80,1	79	77,8	74,3	70,6	9,5	12,0

* rate of nature losses in storage without artificial cooling storage for eight months (September to May) is 6.9%

According to research data, the most intense mass loss as biochemical parameters were in the first and last two months of storage. Most regular intervals during the storage lost in the mass of the tuber varieties Alvar. Major tuber varieties Labadiya the first two months of storage (between September and October) lost 1.3 g or 1.3 % of the original mass. Then as losses from small tubers were respectively 1.5 % of the initial mass for last two months of storage tubers lost control variant in average of 9.2 g or 9.3 % of the original mass.

During potato storage losses were determined from lesions of disease. Research has shown, losses during storage of tubers from damage by diseases were not significant.

The main cause of loss of tubers during storage has been the development fomoz. Loss of potato varieties research due to lesions of disease during the entire period of storage of small: the largest following types of losses were recorded in grades Ramos and Alvaro, respectively 7 and 6.5%. The least affected were tuber varieties Labadiya - 3.5 %, which is 0.8 % less than the tuber varieties Fantasy (control).

For households engaged in cultivation and storage of potatoes is an important value, state of preservation after the storage period, as this index is largely dependent efficiency and profitability as a whole. Stored tubers varieties studied by the end of May - a period when all ends planting tubers for the new crop, and ensure there are young tubers.

The overall results of safety potato varieties studied are presented in Table 3.

Table 3

Preservation of potato tubers of different varieties during 8 months of storage, % (average for the period September - May 2011-2012)

Variety	Output commodity tubers		Technical waste	Absolute waste	Nature losses	Total losses
	%	± to control				
Fantasy (control)	83,8	–	2,5	4,4	9,3	16,2
Alvar	79,1	-4,7	4,0	6,8	10,1	20,9
Satin	79,8	-4,0	8,3	3,9	8,0	20,2
Labadiya	85,9	+2,1	2,3	3,6	8,2	14,1
Ramos	78,8	-5,0	2,1	7,1	12,0	21,2

Best of preservation had tuber varieties Labadiya (total losses up 14.1%) and Fantasia (16.2%). They found the highest yield of healthy tubers – 85.9 and 83.8 %,

respectively. The largest number of total losses was found in samples of a variety of accounting Ramos-21.2 %, a 5.0 % increase over the control.

The largest number of technical marriage is set in a sort of Satin in which it was 8.3 %, up 5.8 % compared with the control variety. This result is due primarily to a large number of mechanically damaged tubers. Rather high, the figure was in grade Alvar - 4.0 %. The least technical marriage after storage installed in grades Ramos and Labadiya - 2.1 and 2.3 %, respectively.

To absolute waste fractions attributed completely unsuitable for further using. Here, the prevailing rotten tubers and sprouts. The smallest absolute amount of waste found in varieties Labadiya and Satin - 3.6 and 3.9 %, respectively. The high numbers of them were in Alvar and Ramos - 6.8 and 7.1 %, respectively. For this, the absolute fraction of waste in the tubers of varieties dominated rotten tubers. Content was rather high absolute waste and Fantasy - 4.4%. However, in this case dominated not rotten tubers, shoots and weight. It should be noted that the tubers of the variety Fantasy germination most among the studied assortments. This is reflected in the value of attrition. The highest losses were natural varieties and Ramos Alvar – 12.0 and 10.1 %. Overall, this indicator all studied varieties dominated allowable loss. The smallest set of varieties Labadiya and Satin - 8.0 and 8.2 %, respectively.

Over the years, studies after 8 months of storage of all eight experimental varieties retained commodity. Their marketability were to range 78.8 - 85.9 % (Table 4).

It is greatest number of healthy tubers among the studied assortments after storage installed in a variety Labadiya - 85.9 % (2.1 % compared to the standard). The lowest number of commodity storage tubers after completion of the varieties found Ramos and Alvar - 78.8 and 79.1 %, respectively.

Table 4

Change in commodity quality of potato tubers during storage, %

Indicators, control periods	Tubers of potato varieties				
	Fantasy (control)	Alvar	Satin	Labadiya	Ramos

1. Commodity tubers for storage, %	85,9	81,3	82,2	90	81,6
2. After 6 months of storage detected %: - healthy tubers	85,5	80,6	81,8	89,4	80,0
- technical waste	2,1	1,7	4,5	5,8	5,8
- absolute waste	-	-	-	-	-
3. After 6 months of storage detected %: - healthy tubers	84,6	79,9	80,9	87,2	79,3
- technical waste	2,3	1,9	4,7	6,0	6,1
- absolute waste	-	1,1	-	-	1,3
4. After 8 months of storage detected %: - healthy tubers	83,8	79,1	79,8	85,9	78,8
- technical waste	2,5	4,0	8,3	2,3	2,1
- absolute waste	4,4	6,8	3,9	3,6	7,1

As shown in the Table. 4, after 4 months storage of potato tubers have not experienced significant losses, absolute waste were observed. Just after 6 months of storage revealed an absolute waste in varieties Alvar and Ramos - 1.1 - 1.3% , respectively. At the end of storage in tubers increased absolute waste of content in five potato varieties studied.

So after eight months of storage for storing the best results were obtained in Fantasy and Labadiya. They found the largest number of commodity bubbles to 83.8 and 85.9 %, respectively.

In general, the implementation of potato varieties studied advisable to carry out the end of March, which will provide high marketable tubers and minimal losses.

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J11409-010

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THE COMPARATVE DESCRIPTION OF QUANTITY, QUALITY OF GLUTEN DURING GRAIN AND FLOUR STORAGE

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Abstract. The dependency of changing of quantity and quality of gluten, which storage in the unregulated conditions during 24 months are presented.

Key words:Grain, flour, quantity and quality of gluten.

A grain, like any living organism is constantly undergoing complex biochemical processes, the intensity of which depends on environmental conditions - humidity , temperature and aeration.

However, not all grain can keep qualitative and quantitative indicators prior to its use. This is because different lots of grain, especially freshly characterized by different physical and biochemical processes that can lead to an improvement or deterioration in its quality.

One of grain processing products is flour. The flour is a mass of fine particles that have lost the protective shell grains were easily accessible and action environmental conditions. The flour consists of tissue particles, it has not lost the ability to biochemical changes.

The aim of our research was to study the changes in technological properties of grain and flour during storage that based on the varietal characteristics of culture and comparative evaluation of the efficiency of grain storage and flour that derived from it.

The special and general scientific methods were used. The conventional methods to assess in laboratory assays were used. The experimental research was conducted at the department of engineering, storage, processing and product standardization of prof. B.V. Lesik. The object of research was a grain shipment and

flour recognized varieties of winter wheat **:** Poliska 90, Tsiganka, Nikoniya Perlina Lisostepu.

The program of research included evaluation of the quality of grain and flour immediately after harvesting (control), after 1, 3, 6, 9, 12, 15, 18 and 24 storage months.

Results. It was found that the value of the amount of gluten in the flour Poliska 90 increased during 6 months of storage and then started to decrease gradually and at the end of the study reached control (table 1). It increased during the first 9 months of storage in a variety Tsiganka at 0.9%. A sort Perlina Lisostepu an amount of gluten remained virtually unchanged.

Table 1

The changing the amount of gluten in the flour during storage of grain, %

Variety	Control	Storage term, months							
		1	3	6	9	12	15	18	24
Poliska 90	21.6	22.6	23.0	23.3	22.8	22.2	21.9	21.7	21.5
Tsiganka	25.9	26.4	26.4	26.2	26.8	25.0	25.5	25.2	25.1
Nikoniya	19.8	19.7	20,4	20.7	20.2	19.7	19.6	19.5	19.5
Perlina Lisostepu	21.5	21.6	21.8	21.8	21.6	21.4	21.8	21.6	21.2

The flour obtained from grain varieties Poliska 90, Tsiganka, Nikoniya, Perlina Lisostepu which persisted for 24 months was investigated and storage term was estimated.

According to the results from the table. 2 can be observed change in the amount of gluten in the flour during storage.

It should be noted that the amount of gluten in the flour after one month of storage comparing increased to control in a variety Poliska 90-0,7 % and for variety Tsiganka 0.4 %, for varieties Nikoniya, Perlina Lisostepu remained unchanged . Major changes have occurred in the flour grade Poliska 90. After 12 months of

storage the amount of gluten was decreased by 2.9% compared to the control and remained so until the end of storage. Number of gluten in the flour variety Tsiganka within 15 months of storage remained at the level of control, but in recent months storage decreased compared with control at 2.1%. The smallest amount of gluten losses was observed in flour of a variety Nikoniya, that constituting only 0.4 % for the entire period of storage. The loss of the amount of gluten in the flour of a variety Perlina Lisostepu was occured gradually throughout the storage period and up to the end of the storage of 1.4% compared to control.

An amount of gluten in the flour during prolonged storage reduced by reducing its hydration.

Table 2

The changing the amount of gluten in the flour during storage, %

Variety	Control	Storage term, months							
		1	3	6	9	12	15	18	24
Poliska 90	21.6	22.3	21.7	19.4	18.6	18.8	18.9	19.1	18.7
Tsiganka	25.9	26.3	26.2	25.5	25.4	25.7	25.7	24.7	23.8
Nikoniya	19.8	20.0	20.4	19.9	19.6	20.1	19.4	19.4	18.4
Perlina Lisostepu	21.5	21.5	21.5	21.6	21.1	21.0	21.0	21.3	20.1

An amount of gluten in the flour storage increased in the first 3 months. While the flour obtained from grain during storage increased the gluten content for 6 months.

When compared flour, which was storaged during the first period, which was prepared from corn after the same period of storage, it should be noted that the grains occurring processes of more complex compounds, leading to an increase in gluten content compared to flour, which remained the same time. So, after 6 months of storage term in three varieties Poliska 90, Tsiganka, Nikoniya, Perlina Lisostepu the gluten content was lower than in the flour from grain received after this period of

storage at 0.2-0.8 %. While in varieties Poliska 90, this difference was 3.9 %, which characterizes it as a variety of long-term post-harvest ripening. After 12 months , this difference leveled off in all sorts and analyzed was 0.4 %. And after 24 months of storage content of gluten in the flour storage fell by 2.8% in variety Poliska 90, and in the other three grades of 1.2%, compared to the flour obtained from grain after 24 months of storage.

During grain storage and flour varies the quantity of gluten and its quality.

Table 3

The changing of the quality of gluten in the process storage, о.п.

Variety	Control	Storage term, months							
		1	3	6	9	12	15	18	24
Poliska 90	85.0	82.5	80.0	75.0	72.5	75.0	75.0	77.5	85.0
Tsiganka	77.5	77.5	67.5	60.0	62.5	72.5	70.0	77.5	80.0
Nikoniya	70.0	62.5	55.0	55.0	60.0	55.0	65.0	65.0	62.5
Perlina Lisostepu	80.0	80.0	80.0	70.0	77.5	72.5	72.5	75.0	82.5

Note (GU) - VDK gear units

The quality of the gluten in the flour during storage of grain varieties varied in many ways. During grain storage of varieties Poliska 90 quality of gluten in the flour at the test definition and at the end of storage was 85.0 gear units. But during grain storage changes in quality ranged from 10 gear units. The same trend was recorded in the variety Perlina Lisostepu. Crop varieties Tsiganka at the beginning of storage was 77.5 gear units. Gluten in this class after 6 -month storage was 60.0 gear units. At the end of the storage device indicator showing 80.0 gear units. The biggest change in the quality was in the grain shipment of variety Nikoniya. The most strong gluten was from 3 to 9 months of storage. At the end of storage quality of gluten in the flour of this variety during grain storage was 67.5 gear units.

The results of our studies (Table 4) shows that the quality of the gluten in the flour storage increases, gluten eventually becomes less elastic and loses extensibility .

Table4

The changing of the quality of gluten in the process flour storage, о.п.

Variety	Control	Storage term, months							
		1	3	6	9	12	15	18	24
Poliska 90	85.0	77.5	72.5	65.0	62.5	62.5	57.5	52.5	42.5
Tsiganka	75.5	70.5	62.5	62.5	65.0	62.5	62.5	60.0	47.5
Nikoniya	70.0	60.0	60.5	52.5	45.0	47.5	47.5	45.0	40.0
Perlina Lisostepu	80.0	75.0	72.5	70.0	65.0	65.0	62.5	60.0	52.5

Note (GU) - VDK gear units

At the beginning of flour storage gluten all grades had good quality, but its quality during storage was changed toward strengthening. The change in quality occurred gradually throughout the storage term of flour. And after 24 months of storage quality of gluten in the flour storage was in variety Poliska 90 - 42.5 gear units, Tsiganka - 47.5 gear units; Nikoniya - 40.0 gear units, Perlina Lisostepu - at 52.5 gear units

Conclusions: 1. Indicators of quality of flour during storage deteriorated to a greater extent than in the grain storage and later as received with flour.

2. To obtain high-quality bakery products appropriate to carry out the storage of wheat for food to grain and as needed to process it into flour and softened up to 3 months.

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Nemeikšienė D.

UNLIMITTED POTENTIAL OF USAGE OF GREEN MANURE AS NITROGEN SOURCE IN ORGANIC AGRICULTURE

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Abstract. Results of perennial grasses (*Trifolium pratense L., Medicago sativa L., xFestulolium*), as usage methods of preceding crops and their aboveground mass (for harvest and green manure), effect on $\mathbf{N_{inorg}}$ amount in soil in ecological farming were compared. Field experiments were carried out at Joniškėlis Research Station of Lithuanian Institute of Agriculture LRCAF on a Endocalcari – Endohypogleyic Cambisol, chemical analysis – in Laboratory of Chemical Researches of LIA. It was established, that in aboveground mass of red clover and Lucerne using mixed management method (first grass harvested, second and third used for green fertilizer), N accumulated respectively 148.4-153.0 and 149.0-151.2 kg ha^{-1} while using mulching method respectively – 253.6-268.8 and 216.0-249.9 kg ha^{-1}.

Key words: perennial grasses, mulching, $N_{inorg.}$, C:N ratio, lignin:N ratio

Introduction. Majority of European scientists suggests to apply, in sparing and ecological farms, flexible technological links, to increase biodiversity, to mobilize nutrients (nitrogen), including them into a biogenic elements metabolic cycle inside of agrosystem, decrease nutrients‘ (esp. nitrogen) elution, to stop degradation of a soil, extinction of humus, to encourage natural biological processes, with improving balance of organic carbon and nitrogen metabolism in fields [3].

The base of organic farming should have multi-structural composition with legumes (*Leguminosae*), cattle and production, oriented towards the closed cycle of nutrient circulation [6]. Organic farming, unlike conventional farming, has complex relationships between different components of the agro-ecosystem and the quantity and quality of the final products depend on the functioning of the entire system [5]. Research data, concerning effect of remains of legumes, incorporated to soil as well

as aboveground biomass on nitrogen leach is ambiguous. If compared to intensive application of mineral nitrogen fertilizers, inclusion of perennial legumes to crop rotation reduces the risk of nitrogen leach. Studies that have simultaneously compared the fate of both sources of N suggest that in rain-fed agricultures, crops recover more N from mineral fertilizer, but a higher proportion of the legume N is retained in the soil [2]. Despite mentioned above, data of foreign and Lithuanian researchers indicate that incorporation of biomass of legumes for winter wheat can lead to mineral nitrogen leach during the period of autumn – winter – early spring, due to a rapid mineralization of biomass, rich in nitrogen [10; 1; 7]. According to Austrian scientists, under conditions of warmer and longer autumn, $N_{inorg.}$ content in 0–150 cm soil layer can reach 100–200 kg ha^{-1} [4]. Studies, carried out in Lithuania, in sandy loam Luvisol, indicated that tillage of the green manure (lupin or clover aftermath) for winter crop, decomposition of organic matters had been rapid and nitrogen leach to the subsoil (25–100 cm) in October and November had increased by averagely 24-63%, if compared to stubble tillage [10] .

The aim of these researches is to assess the effect of application of innovative green manure technologies on mineralisation of perennial grasses biomass as well as on environmental effect.

Materials and methods. Site and soil. Experiments were set up in 2007-2009 at the LRCAF Joniškėlis Research Station on an *Endocalcari–Endohypogleyic Cambisol*, the texture of which is heavy clay loam (clay particles < 0,002 mm in Ap horizon (0–30 cm) is 27.0%), on silty clay with deeper lying sandy loam. Parental rock is limnoglacial clay, which transforms to morenic clay loam in the depth of 70-80 cm. Density of these soils in ploughlayer is 1.5 Mg m^{-3}, general porosity 41–43%, airing porosity - 15–17%. Agrochemical characteristics of the ploughlayer: Experiment I was established in 2008, the soil was moderate in phosphorus 142 mg kg^{-1} P_2O_5 and high in potassium 223 mg kg^{-1} K_2O, with $N_{tot.}$ of 0.126 %, $C_{org.}$ of 1.67 %. Experiment II was established in 2009, when the soil phosphorus content was 145 mg kg^{-1} P_2O_5 and that of potassium 232 mg kg^{-1} K_2O, with $N_{tot.}$ of 0.138 %, $C_{org.}$ of

1.63 %. Soil and plants analysis were performed in Chemical Research Laboratory of Institute of Agriculture (LIA).

Experimental design and field management. Research was conducted in the following sequence of the crop rotation: spring barley (*Hordeum vulgare* L.) + undersown perennial grass – perennial grass – winter wheat (*Triticum aestivum* L. emend. Fiori et Paol.)– winter triticale (x *Triticosecale* Wittm.). Factor A: perennial grass: 1) festulolium (x *Festulolium*) (control, aboveground biomass removed from the field), 2) red clover (*Trifolium pratense* L.), 3) mixture of red clover and festulolium, 4) lucerne (*Medicago sativa* L.), 5) mixture of lucerne and festulolium Factor B: management methods of aboveground biomass of perennial grass: 1) removed from the field, 2) mixed management, 3) mulching. The aboveground mass of perennial grass is mulched in the soil surface 2–4 times (mixed and mulching management) during the period of vegetation: it is cut, chopped and spread in order to use the biologic nitrogen, bound by legumes more efficiently, and to save the environment from pollution [8]. Chopped mass of legumes is rich in nitrogen and has a property of rapid mineralization; therefore the free nitrogen is bound by intensively growing perennial grass or is incorporated to the content of organic matters of soil [9]. The mentioned above describes how organic compounds, rich in nitrogen, are formed in soil; they have feature of slow mineralization and provide cereals with nutrients for several years or may be incorporated to a more stable content of soil organic compounds [11].

Results and discussion. Aboveground mass, carbon and nitrogen contents used for mulch. Under mixed management of aboveground mass, the mass of forage legumes and their mixtures with grasses used for mulch differed little between themselves 4606.8–4948.4 kg ha^{-1} DM (Experiment I) or 3531.9–4429.3 kg ha^{-1} DM (Experiment II). The amount of aboveground herbage mass used for mulch depended more appreciably on the plant species only in Experiment II: it was the highest of red clover and its mixture with festulolium, while it was the lowest of lucerne and festulolium mixture.

When the whole aboveground mass was mulched, the mass of forage legumes and their mixtures with legumes used for mulch increased by 1.4–1.8 times, compared with mixed management (according to the data from Experiment I and II). According to reducing aboveground mass, used for mulch, perennial forage legumes and grasses can be ranked in the following order: red clover and festulolium mixture > red clover > lucerne and festulolium mixture > lucerne > festulolium.

In the aboveground mass of forage legumes and their mixtures with festulolium, before mulching (mixed management) C content was 2.4–2.8 times higher compared with sole/pure festulolium (Table 1).

Table 1.

Aboveground mass of perennial forage legumes and grasses, used for mulch, and carbon and nitrogen content accumulated in it (Joniškėlis Experimental Station, 2008 and 2009)

Perennial grasses (A)	Management methods of perennial grasses (B)							
	mixed				mulching			
	C kg ha-^{1}		N kg ha-^{1}		C kg ha-^{1}		N kg ha-^{1}	
	1st Exp.	2nd Exp	1st Exp.	2nd Exp	1st Exp.	2nd Exp	1st Exp.	2nd Exp
Fl	1041.5	778.4	30.4	24.2	2418.9	2339.9	55.4	61.9
RC	2703.2	2356.5	148.4	153.0	4367.2	4082.4	253.6	268.8
RC+Fl	2487.7	2410.1	113.6	146.4	4577.1	4173.0	219.1	237.6
L	2483.4	2141.3	149.0	151.2	3633.9	2968.9	149.8	216.0
L+Fl	2500.0	1831.7	120.9	115.7	4038.9	3455.2	195.2	182.3
LSD_{05}A	265.06	122.5	12.89	9.49	140.00	117.35	6.89	7.16
B	167.64	77.49	8.15	6.00	125.22	104.96	6.16	6.40
AB	374.84	173.27	18.25	13.42	280.01	234.69	13.78	14.32

Note: Fl – festulolium; RC – red clover; RC+Fl – red clover + festulolium; L – lucerne; L+Fl – liucerne + festulolium

The highest C concentration was utilized when mulching whole aboveground mass of red clover and its mixture with festulolium i.e. 1.6–1.8 times more than under

mixed management of the aboveground mass. However, in the aboveground mass of lucerne and its mixture with festulolium, used for mulch, C content markedly differed between themselves and between experiments.

Having used part of the aboveground mass of perennial forage legumes and grasses as mulch (mixed management), the highest N content was in the mass of sole forage legumes. In the aboveground mass of forage legumes and festulolium mixtures N content was 18.9–23.5 % lower (except for mulch of red clover and festulolium mixture, experiment II), compared with respective sole forage legumes mass.

Mineralization indicators of the aboveground mass. The data of both experiments indicated the highest C:N ratio in the festulolium mass. This ratio reduced when growing festulolium in mixtures with forage legumes (especially with red clover) and when cutting herbage for mulch. The most favourable for decomposition biomass ratio (C:N = 13–20) was of red clover and lucerne mulch. The C:N ratio of the aboveground mass of mixtures of forage legumes with festulolium was only inappreciably higher (C:N = 15–29). The C:N ratio declined with a delay in herbage cutting time for mulch (Table 2).

Table 2.

Mineralization indicators of the aboveground mass of perennial forage legumes and grasses, used for mulch

(Joniškėlis Experimental Station, 2008 and 2009)

Perennial grasses (A)	Management methods of perennial grasses (B)							
	mixed				mulching			
	C:N		lignin:N		C:N		lignin:N	
	1st Exp.	2nd Exp	1st Exp.	2nd Exp	1st Exp.	2nd Exp	1st Exp.	2nd Exp
Fl	27–47	30–34	14–17	8–10	36–44	27–45	13–22	6–12
RC	18–27	15–16	9–10	7–9	15–20	13-17	5–11	5–8
RC+Fl	20–27	16–23	9–11	7	20–27	15–21	7–11	6–8
L	16–17	14	9	6	13–17	12–16	5–8	4–6
L+Fl	19–24	15–20	11–14	6–8	19–29	16–27	6–11	5–8
$LSD_{05}A$	6.1	2.2	1.3	0.7	1.1	1.9	0.9	1.0
B	3.8	1.6	0.7	0.3	0.9	1.7	0.8	0.8

AB	8.9	4.2	2.0	1.0	2.3	3.8	1.7	1.8

Note: Fl – festulolium; RC – red clover; RC+Fl – red clover + festulolium; L – lucerne; L+Fl – liucerne + festulolium

The lignin:N ratio of the aboveground mass of perennial grasses used for forage was higher compared with that designed for mulch. In Experiment I, in herbage mulch the lignin:N ratio consistently declined with increasing nitrogen content in the biomass: festulolium (13–22) > forage legumes and festulolium mixtures (6–14) > forage legumes mulch (5–11). In Experiment II, the lignin:N ratio of mulch of perennial grasses (especially festulolium) was lower (5–12) and the differences were less distinct, compared with Experiment I. Only lucerne mulch was distinguished by a lower lignin:N ratio (4–6). Herbage cuts also differed according to the lignin:N ratio. In Experiment I, the lowest lignin:N ratio was identified in the mulch of the first cut of red clover and lucerne, in experiment II in the mulch of last cuts of festulolium, lucerne, and their mixtures.

Inorgaic nitrogen($N_{inorg.}$) The data from both Experiment suggest that having used the aboveground mass of perennial grasses under mixed management, with increasing mass of the second and third cuts, with reducing their C:N and lignin:N ratios, $N_{inorg.}$ in spring increased (r= –0.65**– –0.94**; r= –0.82** – –0.65**; r= –0.79** – –0.57*, respectively). In Experiment II, the dependence of soil $N_{inorg.}$ content on the aboveground mass and its quality remained analogous also in the second year of cereal growing. Having used larger aboveground mass of perennial grasses as green manure (mulching treatment), nitrogen release and plant N demand incompatibility was more distinct, compared with mixed management treatment. In Experiment II, in spring there was established an inverse $N_{inorg.}$ relationship with the C:N ratio of biomass of all cuts (r= –0.81**– –0.82**) and direct relationship with that of herbage biomass of the 2^{nd}–4^{th} cuts (r=0.61*– –0.68**). There was no effect of lignin. While in Experiment I, the C:N and lignin:N ratios of herbage mass of the 2^{nd}–4^{th} cuts influenced $N_{inorg.}$ content in the autumn, in the following year's spring and in both years of cereals growing after their harvesting. With increasing C:N and

lignin:N ratios of the aboveground massof perennial grasses, $N_{inorg.}$ declined (r= –0.63*– –0.71** and r= –0.60* – –0.79**, respectively). The aboveground mass used for mulch did not have any effect.

Conclusions. In the aboveground mass of forage legumes and their mixtures with festulolium C content was significantly higher compared with sole festulolium. The content of C accumulated in herbage mass of different cuts depended on plant species and growing conditions. Mulching of the whole aboveground mass determined higher total nitrogen content accumulated in the herbage biomass.

The mineralization indicators of the aboveground mass, used as green manure depended on the plant species and management method. The highest C:N ratio of the aboveground mass was identified for festulolium (27–47), the lowest for red clover and lucerne (13–20 and 12–17, respectively), mixed crops took an intermediate position (15–29).

The dynamics of mineral nitrogen content variation in the soil depended on the incorporated mass of perennial grasses (mixed management), its C:N and lignin:N ratios (mixed management and mulching) and meteorological conditions during the whole vegetation period (especially autumn).

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TECHNOLOGICAL REPAIR UNIT FOR RENEWAL OF PLOUGH SHARES

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The article is devoted to maximum maintenance and renewal of functional properties of plough shares, subjected to intensive abrasive deterioration, by means of classification and identification of quality characteristics of functional surfaces, development of logic of designing a technological repair unit and a technological repair module.

Key words: *repair, renewal, agricultural machinery, deterioration, plough share, technological repair unit, technological repair module, welding.*

Operating parts of tillage machines (share ploughs and their parts: shares, shin and moldboard wing, etc.; hoes, disc harrows and hoeing ploughs) operate in the conditions of abrasive deterioration, intensified loads and impact of aggressive environment. Their repair means recovering of initial sizes and durability of functional operating surfaces.

Thus, for example, the way and intensity of deterioration of operating parts of plough shares are mainly influenced by mechanical and aggregate soil state in the area of operation. Herewith, crucial parameters affecting the intensity of deterioration of operating parts (mm/ha) are: soil hardness (MPa), angle of cutting the furrow with the share and angle of plough blade placing to furrow side with a glance of width (mm), solidity of anti-wear and main layers (HRC), blade sharpening angle, angle of plough placing to furrow bottom and side, ploughing depth (see figure 1).

Operating parts of modern agricultural machinery are made from bimetal: base layer – from steel 50, 65 G, L 53 and weld hard alloys: Sormite 1, 2, V2K and others. Cutting parts have a characteristic of self-sharpening..

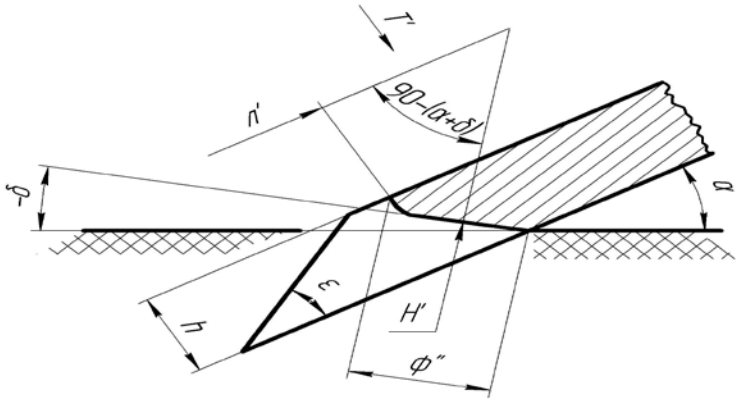


Figure 1 – A diagram of deterioration parameters of plough shares operating parts: ϕ'' - back edge width; α- angle of plough placing to furrow bottom and side; δ - angle formed between back edge and furrow bottom; *h* – blade thickness; T' – direction of deterioration by share thickness; $Л'$ - direction of deterioration by share width; H' - direction of deterioration by formation of back share edge.

The process of renewal can be divided into two stages:

- mechanical recovering of shape and sizes of functional parts;

- theoretical explanation of the method of surfacing the anti-wear coating through creation of information model of technological repair unit [1-5] and its realization.

For solving the set goal the information models of technological repair unit can be presented as criteria of classifying the parts of the object under repair and technological repair unit, herewith, the tribocharacteristics of functional surfaces are expressed through a complex characteristic of equilibrium state of contact surfaces:

$$C = \frac{H_p W_p R_p^4}{S_m^6 И_н^{12} \lambda^6}, \quad (1)$$

in which H_p – macrodiscrepancy flattening height, μm;

W_p – waviness flattening height, μm;

R_p – roughness shape flattening height, μm;

S_m – medium space of shape unevenness, mm;

$И_н$ – rate of cold work hardening, %;

λ – coefficient taking into account the impact of surface residual stresses on deterioration:

$$\lambda = \left(\frac{\sigma_в - \sigma_{ocm}}{\sigma_a} \right)^{ty}, \quad (2)$$

in which $\sigma_в$ – ultimate strength of material, MPa;

$\sigma_{ост}$ – surface residual stress, MPa;

σ_a – active value of amplitude tension on friction surface, MPa;

t_y – parameter of frictional fatigue under elastic contact.

The result of the suggested solution consists in forming a virtual model of technological repair unit, which allows repairing with the required quality characteristics, determined by operation conditions, with a glance of facilities of the given repair activity through a logical search and establishing of their optimum combinations [1,5].

The experimental tests of shares under different methods of renewal of functional surfaces analytically allowed setting the dependence of durability of share parts (relative blade durability $\lambda_л$ and relative point durability $\lambda_н$) on soil hardness (H), on coefficient of plough travel stability (μ), on size of back edge b, on plough travel speed V and on share operation time W.

Main statistical characteristics of the tests and a matrix of paired coefficients of correlation are given in tables 1, 2. Main significant correlations are in formulae 3-9.

Table 1.

Main statistical characteristics

Characteristic	$\lambda_л$	$\lambda_н$	α	H	μ	V	W
Medium	1,94	1,80	7,46	1,92	1,26	2,70	70,62
Maximum	2,59	3,02	12,70	2,90	4,69	2,77	172,00
Minimum	0,98	0,98	2,00	0,90	0,42	2,65	13,10

Mean square deviation	0,55	0,63	4,07	0,72	1,02	0,03	41,54
Coefficient of variation, %	28,47	35,34	54,52	37,56	80,37	1,20	58,82

Table 2.

A matrix of paired coefficients of correlation

Characteristics	$\lambda_л$	$\lambda_н$	α	H	μ	V	W
$\lambda_л$	1,000	0,911	-0,170	-0,200	0,291	0,091	-0,043
$\lambda_н$	0,911	1,000	-0,100	-0,313	0,155	0,088	0,116
α	-0,170	-0,100	1,000	0,000	-0,752	-0,106	0,356
H	-0,200	-0,313	0,000	1,000	-0,411	-0,661	-0,802
μ	0,291	0,155	-0,752	-0,411	1,000	0,288	-0,018
V	0,091	0,088	-0,106	-0,661	0,288	1,000	0,438
W	-0,043	0,116	0,356	-0,802	-0,018	0,438	1,000

$$\lambda_л = 2{,}390471725 + 0{,}1446967021 \cdot H \quad (3)$$

$$\lambda_л = 2{,}456750022 - 0{,}06845832978 \cdot LOG(H) + 0{,}1472488812 \cdot LOG(\mu) \quad (4)$$

$$\lambda_л = 2{,}174592124 - 0{,}4140302118 \cdot LOG(H) + 0{,}08776585099 \cdot LOG(\mu) \quad (5)$$

$$\lambda_н = 2{,}538996217 + 0{,}6476546963 \cdot LOG(H) \quad (6)$$

$$\lambda_н = 2{,}538996217 + 0{,}6476546963 \cdot LOG(H) \quad (7)$$

$$\lambda_н = 2{,}78471573 - 0{,}5486885368 \cdot LOG(H) + 0{,}1583516612 \cdot LOG(\mu) \quad (8)$$

$$\lambda_н = 1{,}837681442 - 0{,}5235618949 \cdot LOG(H) + 0{,}02614132442 \cdot LOG(\mu) \quad (9)$$

A regression mathematical model of the dependence of relative blade durability $\lambda_л$ on soil hardness H and plough travel speed V is as follows:

$$\lambda_л = 8{,}98 \cdot 0{,}914^{H} \cdot 0{,}59^{V} \quad (10)$$

On figures 2, 3 there are presented calculated analytical correlations in a graphic way.

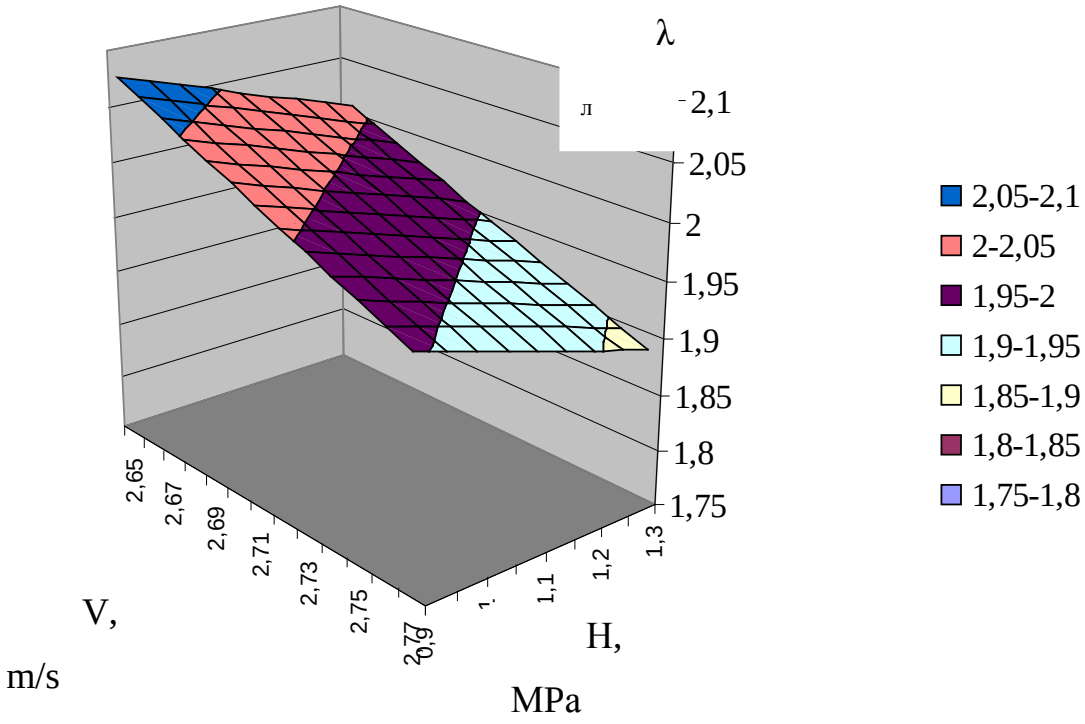


Figure 2 – The surface of response according to the received data of the experiment.

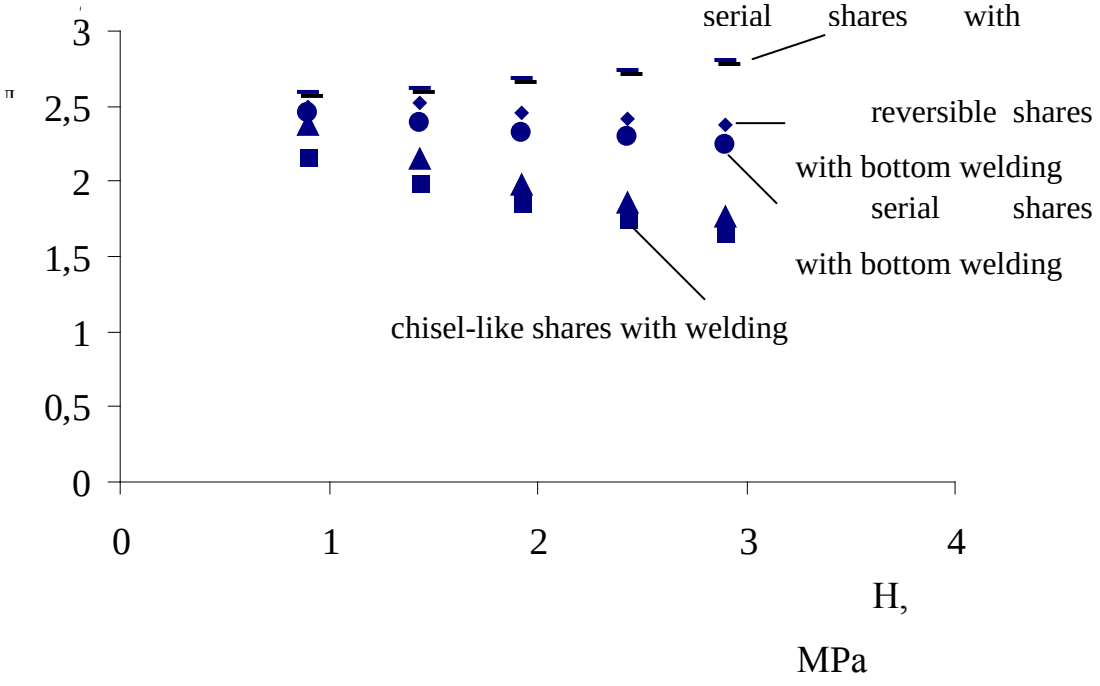


Figure 3 – A diagram of the dependence of relative durability of share blades ($\lambda_л$) with different hardened surfaces on soil hardness, MPa (H).

The approach at choosing a method of repair on the basis of technological repair unit with a glance of revealed analytical dependences during study of shares with different methods of hardening of operating parts was crucial in the study of the most promising ones. On figures 4, 5, 6, 7 there are presented the given methods of renewal.

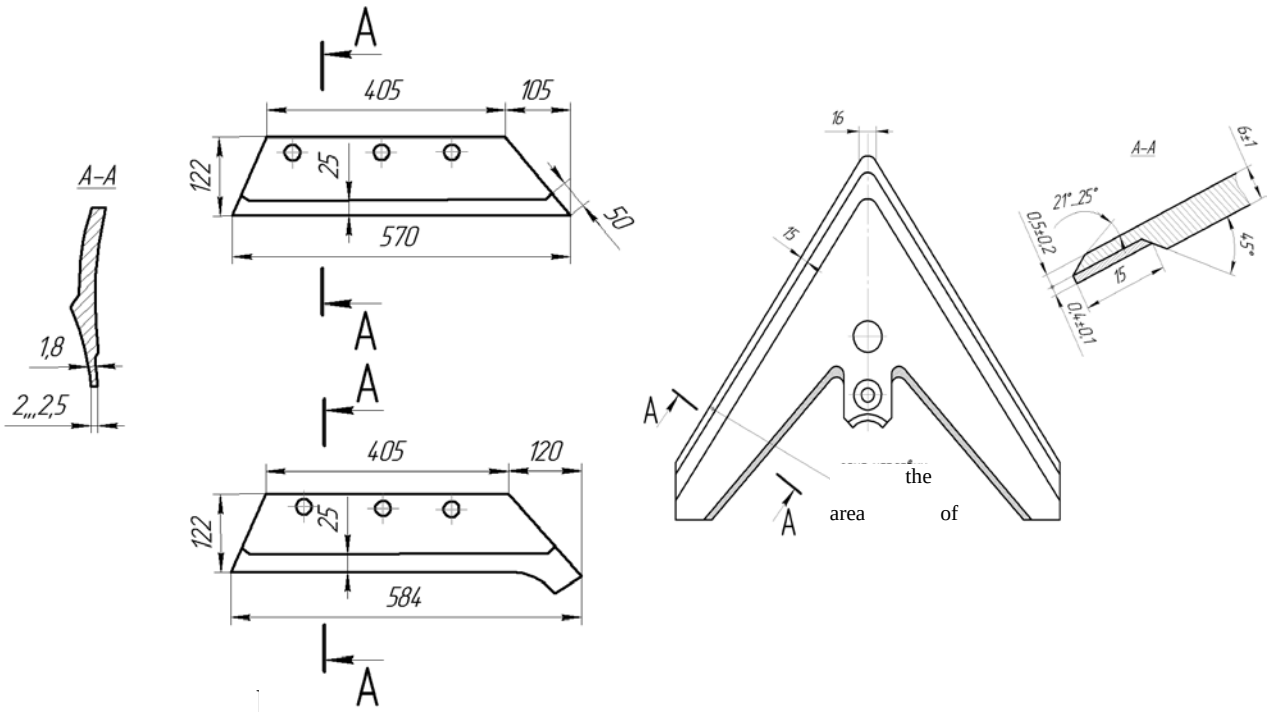
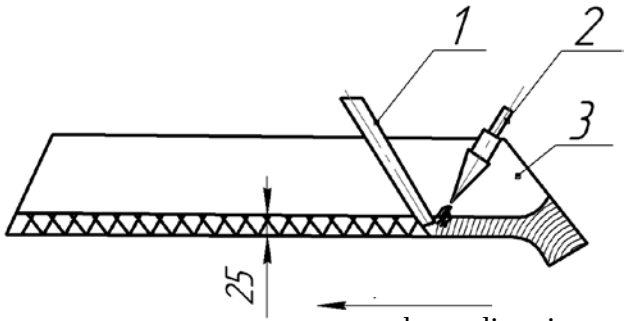


Figure 4 – Operating parts of tillage machines: a – a share with straight blade; b – a share with chisel-like blade; c – hoe



the direction of

Figure 5 – The scheme of welding a share blade with hard alloy with the help of a gas burner: 1 – a bar of hard metal; 2 – flare; 3 – share

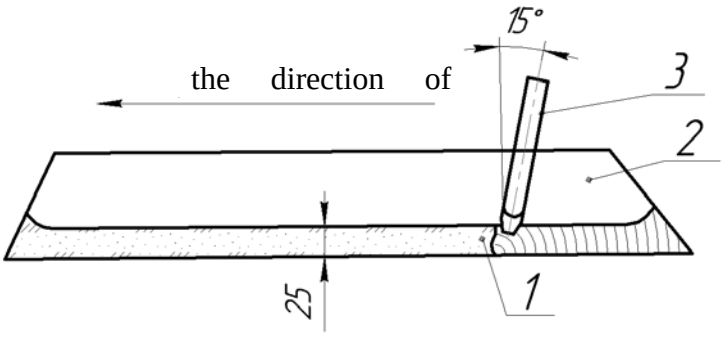


Figure 6 – The scheme of electric-arc welding of share blade with dust-like hard alloy: 1 – charge mixture; 2 – share; 3 – graphite electrode

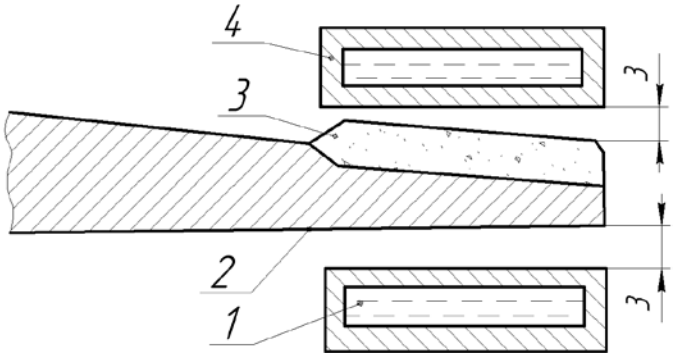


Figure 7 – The scheme of induction welding of share blade with dust-like hard alloy: 1 – cooling liquid; 2 – share; 3 – charge mixture; 4 - inductor

On figure 8 there is presented a structure of technological process of renewal of a set of operating parts of tillage machines; this structure has been chosen as the most acceptable one according to technological and techno-economic criteria.

On the ground of a developed methodology of forming of information model, the authors synthesized a technological repair module for realization of the stages of renewal of plough shares. On figure 9 there is shown a general view of a technological repair module with original technological and engineering ideas [1].

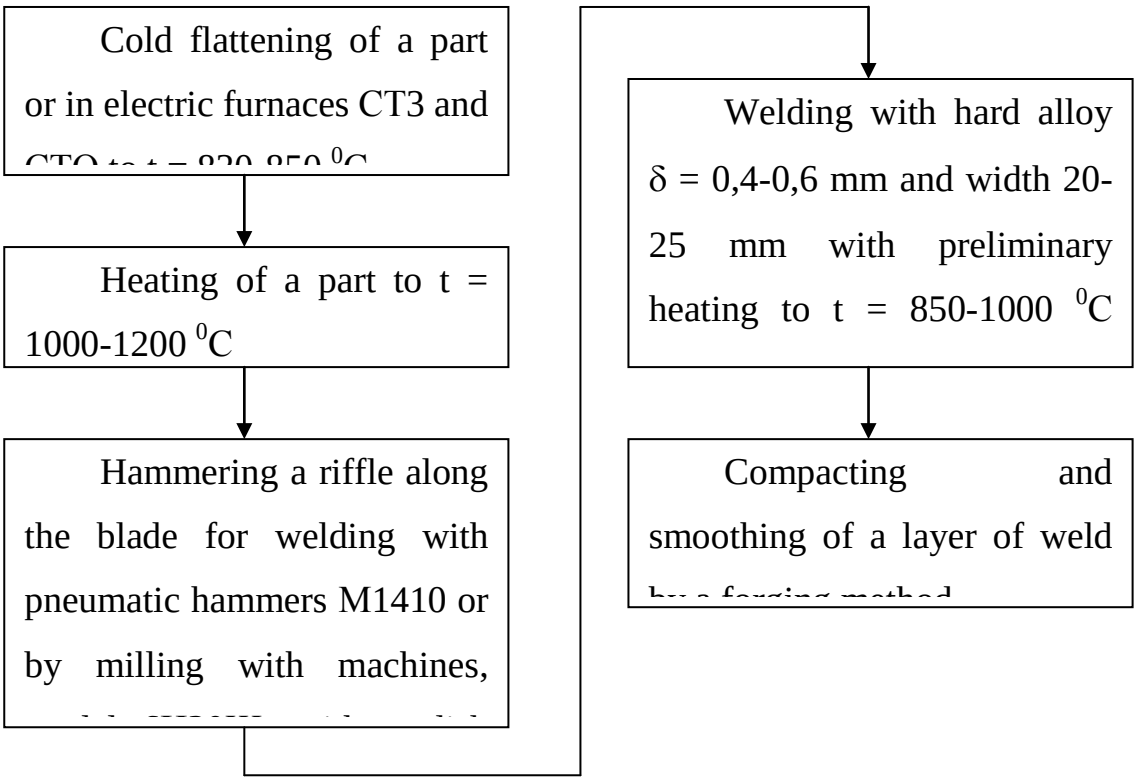


Figure 8 – A structure of technological process of renewal of a set of operating parts

The technological repair module for renewal of operating parts of tillage machines (plough shares) represents a rotary unit, which consists of a rotational movement drive 1 (see figure 9), a rotating platform 2, tilting tables 3 and six operating areas. The principle of operation of the technological repair module is the following: with the help of a rotational movement drive 1 a rotating platform 2, with installed tilting tables on it 3, can rotate about its axis to a required angle, as a result a part under renewal, fixed on a tilting table 3, will be in a necessary position, one of six positions, according to a structure of technological process of renewal of a set of operating parts (see figure 8). Each tilting table 3 allows rotating a fixed part into a necessary position and to a required pitch angle of rotation. A part under renewal is

held on a rotating table with the help of electromagnet. Operating areas are used for flattening, heating, hammering, milling, oxyacetylene surfacing and grinding. Proper places are equipped with necessary technological equipment.

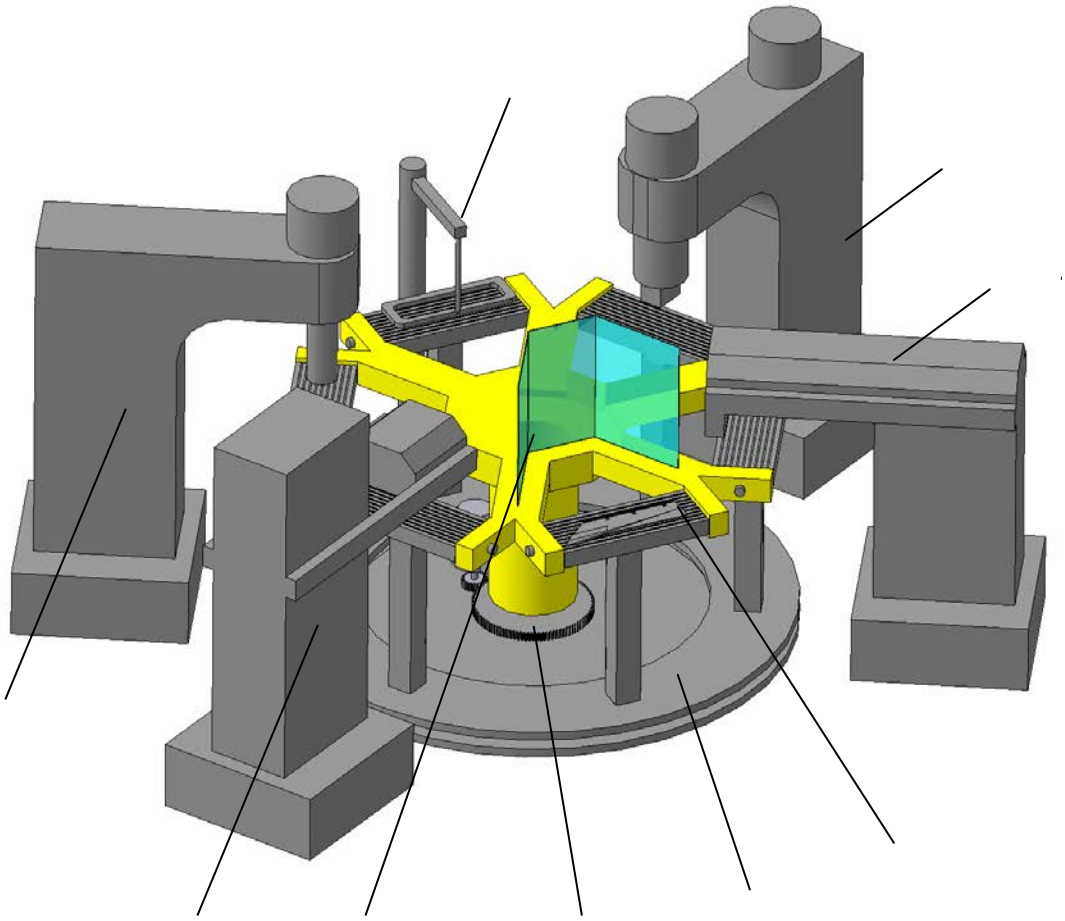


Figure 9 – A technological repair module for renewal of operating parts of tillage machines (according to the technology on figure 8): 1 – a rotational movement drive; 2 – a rotating platform; 3 – a tilting table; 4 – a milling machine, model 6H30III; 5 – a pneumatic forging hammer, model MA4129; 6 – inductor; 7 - a pneumatic press, model IIIIH-1; 8 – a surface-grinding machine, model 3060AH; 9 - welding place (the equipment for welding is not shown).

The essence of the proposed approach to the repair on the basis of technological repair units consisted in classification and logical connection of

identified broken modules of surfaces, operation conditions, methods of repair, technological means, and choice of their optimum combinations. This approach is realized at forming of technological repair units for parts of agricultural machinery and a unit for renewal of operating parts.

A practical realization of the proposed system is the designing of a mechanical complex for renewal of operating parts of tillage machines. A block-module principle is the base of the complex construction, which will allow the renewal of parts of different configuration and overall size through choosing proper units and modules in a necessary combination.

Solving of the set problems will allow creating scientific grounds of technological assurance of machine repair quality.

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METHODOLOGICAL APPROACH TO SHAPING A CLUSTER MANAGEMENT MECHANISM

A proven methodology for shaping a cluster management mechanism in the meat processing industry by building a coordination center.

The current state of Russia's meat processing industry is strongly influenced by such factors as steep competition in both domestic and global meat markets, Russia's accession to the WTO and attendant easing of protectionist barriers, heavy dependence of cattle farming on fodder supply, scarce domestic resources, a high share of imports, as well as other factors. The situation is exacerbated by macroeconomic factors such as heavily depreciated capital stock, limited investments for innovation, low competitiveness, etc. Given these circumstances, Russia could mitigate the threat to its food security by creating an enabling environment for effective performance and development of its meat industry and related sectors.

Building cross-sectoral clusters as strategic alliances could go a long way towards enabling the survival and resistance of the industry in the face of competitive pressures. As international experience shows, building clusters creates favorable conditions for enterprises — both in domestic and external markets — by providing them with easier access to input sources, skilled labor, investments, research, technological and other information, which contributes to higher productivity, encourages innovation, helps grow a broader customer base, implement joint projects, promote cross-sector collaboration, industry specialization and cooperation, etc. [3].

A cross-sectoral cluster should be defined as an integrated and diversified entity built in a given territory at the initiative of individual businesses representing various economic sectors with the objective of cutting overall costs and achieving a sustainable growth trajectory by using modern strategic management methods [1]. The meat industry cluster could feature meat processing factories, agricultural businesses, think tanks, universities, trade organizations, and other infrastructure facilities. A cluster would need an adequate

management mechanism which should be defined as a set of objectives, principles, functions, methods, and tools (adapted to respective managerial impacts), defining the nature of economic interactions, outputs and development trends of the cluster as a whole, as well as its individual participants, over the medium and long term. Such a mechanism could take the form of a coordination center empowered with centralized managerial functions. A methodological approach to creating a mechanism for a cluster coordination center comprises several stages [2].

I. A comprehensive review of businesses operating within the cluster.

II. Defining organizational conditions for building a coordination center.

III. Determining the framework and staffing of the center by identifying units (departments) in charge of coordination, innovation, investments, planning, marketing, information, and other functions (see figure).

IV. Allocating cluster management functions between coordination center units (the list of cluster management functions is defined based on expert surveys).

V. Determining the number of staff of the cluster coordination center. The proposed methodological approach allows to define the number of staff ($Ч_{КЦК}$) required to perform coordination and managerial functions as per the formula:

$$Ч_{КЦК}=T_{фо} / (T_{мес} \cdot 11). \quad (1)$$

where $T_{фо}$ is the total annual labor intensity of managerial functions;

$$T_{фо} = \sum_{i=1}^{n} \sum_{j=1}^{m} t_{ij} T_{рв} k_з \cdot 12 \quad (2)$$

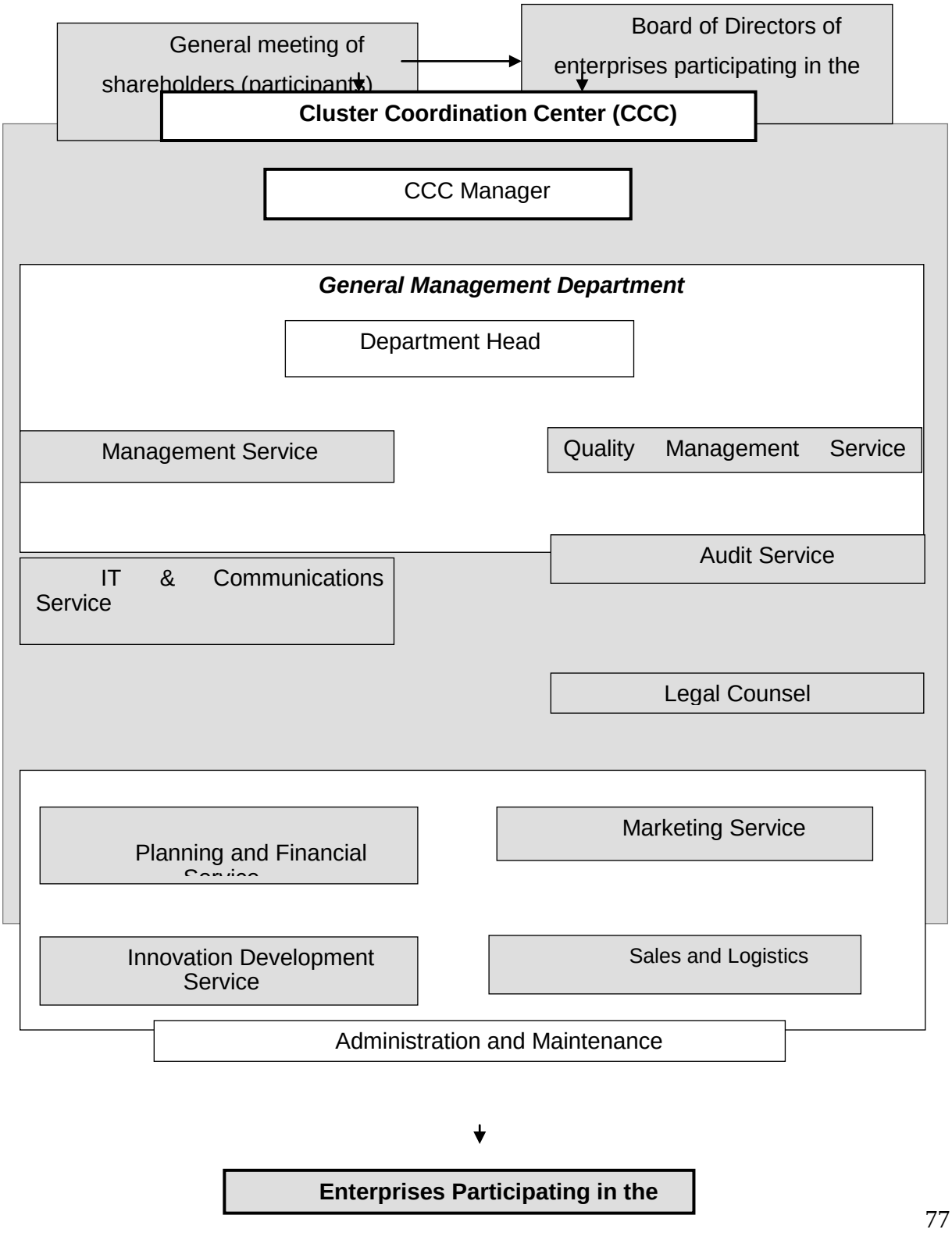
where t_{ij} denotes labor costs per i-managerial function performed by j-category staff (ч);

$T_{рв}$ denotes daily working hours (8 hours); $k_{зj}$ is the coefficient denoting the share of time spent on managerial functions relative to total time).

As follows from the calculations, the coordination center for the meat processing cluster should be staffed with 31 employees, comprising 1 manager, 10 unit heads and senior managers, and 4 technical staff (see figure).

IV. Determining CCC operational costs.

The cost estimate for the center includes: tangible costs ($З_м$), payroll fund with accruals ($Ф_{ЗП}^{КП}$)), depreciation (A), and other costs ($З_{пр}$).



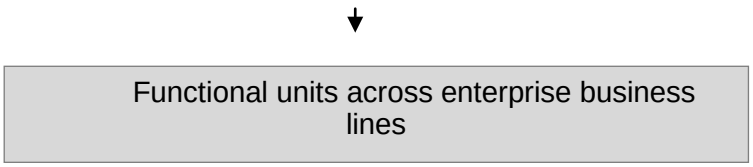


Figure. Cluster Management Mechanism Framework

V. Evaluating the rationale for creating the center. A CCC performing managerial functions would be practical under the following assumptions:

$$\sum_{i=1}^{n} З_i^{КЦК} < \sum_{i=1}^{n} З_i^{п} \quad (3)$$

An entity performing coordination and managerial functions (as illustrated by a meat processing cluster project) would generate annual cost savings of Rub 18.4 million.

The proposed methodological recommendations for coordinating interactions between cluster participants through synergies would enhance management quality, help achieve balanced performance of the integrated entity, generate savings, and promote sustainable development of the competitive cluster in the meat market.

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