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QUALITY OF WINTER WHEAT GRAIN DEPENDING ON GROWING CONDITIONS

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Abstract. Winter wheat is grown for food purposes in the Middle pre-Ural region, therefore, the management of quality indicators under the influence of technological techniques is of great importance. The purpose of the research is to evaluate the effectiveness of using the pre-sowing seed treatment and soil compaction after sowing in the technology of cultivating winter wheat varieties Mera and Italmas for food purposes. The tasks of the research are: to assess the quality of grown grain; to establish the nature of genotype-environmental interactions and the degree of influence of meteorological conditions on grain quality indicators. The research was conducted as the three-factor experiment in the Udmurt Agricultural Research Institute in 2020–2023. Factor A is a variety; factor B is the pre-sowing seed treatment with Vial Trust fungicide (0.4 l/t) in the pure state and in tank mixtures with Vostok Em-1 (0.1 l/t), Flavobacterin (0.5 l/t), Pseudobacterin-2, ZH (1.0 l/t), Humate +7 Zdoroviy urozhay (1.0 l/t), Grow B (100 ml/t), Microvit (0.8 l/t) and Agree's Forsazh (1.5 l/t); factor C – soil compaction after sowing. The analysis of genotype-environmental interactions on the variability of grain quality indicators revealed that the variety had the greatest influence on the variation of vitreousness, quantity and quality of gluten (45–74 %); pre-sowing seed treatment and the interaction of factors had the greatest influence on grain nature - (respectively 40 % and 43 %); only the variety had a significant influence on protein mass fraction (17 %). We established a significant strong inverse correlation of gluten quality with HTC during the grain ripening period (r = -0.82±0.58) and a strong direct correlation (r = 0.91±0.42) with the effective heat sum. The other indicators were not significantly affected by the conditions. As a result of the conducted studies, it was not possible to establish a general pattern of variability in grain quality indicators under the influence of the studied agribusiness practices, which had both positive and negative effects. Nevertheless, the grain obtained during the research experiments meets the requirements of class III GOST 9353-2016 "Wheat. Technical conditions" according to the totality of the analyzed indicators and can be used for food purposes.

Key words: seed treatment, soil compaction after sowing, meteorological factors, grain quality indicators, correlation.

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Original article
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EFFECT OF BIOLOGICAL FERTILIZERS AZOTOVITE AND PHOSPHATOVITE ON YIELDS OF POTATOES GROWN ON SODDY MEDIUM-PODZOLIC MEDIUM LOAMY SOILS IN THE MIDDLE PRE-URALS

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Abstract. The paper examines the effect of biological fertilizers Azotovite and Phosphatovite on yields of potatoes cultivated on sod-podzolic soils in the Middle pre-Ural region. The study aims to investigate the efficacy of different methods of applying these biological fertilizers in potato cultivation. During the field two-factor experiments conducted in 2019–2023 we explored various methods of using Azotovite and Phosphatovite: treating tubers before planting and treating tubers in combination with irrigation at the budding stage. Our findings indicated that the application of these biological fertilizers had a positive effect on potato productivity. On average, during the study period there was a significant increase in output with 5.8 t/ha resulting from the use of Azotovite and 4.8 t/ha due to Phosphatovite. The most effective method of application of Azotovite was found to be during tuber processing and watering at the budding stage. This method provided an increase in yield of 13.6 t/ha in 2020. The tuber yield for commercial purposes also depended on the utilization of biological fertilizers; the application of Azotovite for tuber treatment increased this indicator on average by 6.5 %, while the use of Phosphatovite provided the increase only by 1.8 %. Overall, the use of both Azotovite and Phosphatovite separately resulted in a substantial increase in commercial output by 3.2–17.1 t/ha. However, using a combination of these products exclusively for tuber treatment decreased the commercial yield. The method of irrigation during the budding stage showed a significant increase by 3.2–13.6 t/ha on average, depending on the specific fertilizer preparation used. A tendency was observed that the application of the biological fertilizers Azotovite and Phosphatovite provided an increase of a reproduction coefficient and in the yield of food and seed fractions.

Key words: potatoes, biological fertilizers, Azotovite, Phosphatovite, total yield, commercial yield.

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DYNAMICS OF GRAIN CROPS YIELD IN THE UDMURT REPUBLIC AT THE TURN OF THE XX-XXI CENTURIES

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Abstract. The purpose of the study was to establish current trends in the dynamics of exogenous and endogenous factors and to assess the nature of their impact on grain crops yields in the Udmurt Republic. A correlation and regression analysis of yield, temperature and precipitation data in the Udmurt Republic for two periods limited by 2000 was carried out. Conclusions were drawn about the dynamics of grain crops yields, of exogenous factors – temperature and precipitation. The analysis of temperature dynamics during the growing season in the Udmurt Republic showed an increase in the average temperature increment from 0.1 °C/10 years in 1976–1999 (period I) to 0.7 °C/10 years in 2000–2023 (period II). On the other hand, during the period I the effect of temperature on yield was strong and negative with a correlation coefficient r = -0.79 and a coefficient of determination d = 63 %. These figures indicate that the increase in temperature had a negative and strong effect on yields. During the period II the negative effect of an increase in temperature decreased and became weak: r = -0.17 with a coefficient of determination d = 3 %. The analysis of the effect of precipitation on yield showed that in the period I this dependence was positive, weak with a correlation coefficient r = 0.30 and a determination coefficient d = 9 %, and in the period II it was weakly negative (r = -0.21 and d = 4 %). Thus, the strength of the influence of exogenous factors (temperature and precipitation) on yields over the considered time periods 1976–1999 and 2000–2023 decreased in temperature from 63 to 3 %, in precipitation from 9 to 4%. Such a decrease in the influence of exogenous factors on productivity occurred with an increase in the influence of endogenous factors (biological and organizational-technogenic) from 1 to 44 %. Therefore, despite the decrease in the favorability of exogenous factors the grain crops yields increased by 21 % (from 13.2 to 16.0 c/ha) in the period II.

Key words: yield, temperature, precipitation, linear regression, coefficients of correlation, regression and determination, endogenous and exogenous factors.

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EFFECT OF POULTRY MANURE ON SPRING RAPE PRODUCTIVITY

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Abstract. The use of poultry manure in the agro-industrial complex, taking into account the regulations of its treatment in the environment as animal husbandry by-products, is impossible without detailed study of its effect on specific crops in different climatic conditions. Therefore, the research purpose was to study the influence of different doses of bulk poultry manure (4, 6 and 8 t/ha) on the productivity of spring rape variety Lunedi. The research was carried out on the light gray forest loamy soil on the garden plot of the Nizhny Novgorod State Agrotechnological University in 2022 and 2023. Phenological observations of the growth phases of spring rape showed that its growth and development depended on the supply of plant nutrients. This was confirmed by differences in plant height and the formation of a leaf rosette, leaf color, timing and duration of development phases. It was established that on average for 2 years there was a significant increase in plant height – by 19.4–21.0 % and in the mass of a single plant – by 39.5–85.6 % in the fertilized plots. The increase in total plant biomass on the fertilized plots varied from 6.03 to 8.7 t/ha, and seed yield - from 0.94 to 1.26 t/ha. The minimum dose of poultry manure of 4 t/ha insures agronomic effectiveness, providing a payback of 1 kg of NPK introduced with manure, in 4.6 kg of yield increase of rape seeds.

Key words: spring rape, bedding bulk poultry manure, productivity, agronomic efficiency**.**
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YIELD FORMATION OF THE VARIETIES OF SPRING TRITICALE AND SPRING WHEAT IN THE MIDDLE PRE-URALS

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Abstract. Along with spring wheat, a new crop began to spread – spring triticale, an interesting and promising crop for the Udmurt Republic and Russia. The research purpose is a comparative assessment of the yield formation of spring triticale and spring wheat varieties in the conditions of the Udmurt Republic. The research was conducted at the experimental field of the Udmurt State Agricultural University, according to the requirements of the Methodology of the state variety testing of agricultural crops in 2022–2023. During the experiment 3 spring wheat varieties recommended for cultivation in the region, and 10 spring triticale varieties were tested. Spring triticale varieties, on average for two years of research, provided higher yields than spring wheat varieties by 0.32 t/ha, or 8 %. The variety Timur was predominant among the studied varieties of spring triticale, on average for two years it formed a high yield of 4.72 t/ha. The variety Dobroe turned out to be more resistant to extreme drought conditions in 2023, its yield was 2.21 t/ha. The correlation analysis showed that the greatest impact on the yield of spring triticale and spring wheat was exerted by ear productivity indicators – the grain weight per the ear, the number of grains in the ear and the thousand grain weight. On average for the experiment, a significant direct correlation of moderate strength was established with these indicators (r = 0.35±0.21 ... 0.61±0.18 in 2022; r = 0.58 ± 0.23 ... 0.66 ± 0.21 in 2023). The production inspection in the farm Ecoferma Dubrovskoye in 2023 showed that the yield of spring triticale Dobroye was 2.61 t/ha, which was formed by a productive stem of 380 pcs/m^2 and an average grain weight of 0.79 g per ear. According to the set of quality indicators regulated by GOST 53899-2010 “Fodder triticale. Technical conditions” (content of dry matter, protein, ash), the grain grown in the farm met the requirements of Class III. The dry matter of the grain contained 1.32 feed units and 12.8 MJ/kg of exchange energy calculated for cattle and sheep.

Key words: yield, yield structure, ear productivity, correlation, quality of fodder triticale grain.

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GREEN INFRASTRUCTURE OF TARKO-SALE TOWN IN YAMALO-NENETS AUTONOMOUS DISTRICT

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Abstract. The development of green infrastructure in cities is one of the priorities of Russia's environmental programs. Such studies are conducted in large cities, but in case of small towns, especially in the North, this problem has not been solved and has not even been thoroughly studied. Tarko-Sale in Yamalo-Nenets Autonomous District is an example of such town. In order to identify the features of the green infrastructure of the town, a survey of all the landscaping facilities of the town was conducted. In addition to studying archival materials and urban planning documents, plantings of 34 streets and three squares in the residential part of the city with a total length of 21,230 km were described and mapped, where 4,306 specimens of trees and shrubs were found to grow. The research results provide an opportunity to claim that Tarko-Sale has "green cores" as part of the infrastructure, that is, objects influencing greatly the microclimate of the town. These are large parks called Pribrezhniy and Zdorovie. But the linear objects that should connect them into a single frame are very weak. Only 30 % of the length of all streets has a density of plantings of 2–3 items per 10 meters of length along roads, and 13 % of streets have no trees or lawns at all. The green infrastructure of Tarko-Sale can be defined as incomplete, poorly functioning. For its development, it is necessary to increase the number of trees in urban linear landscaping elements: street plantings and small squares stretched along the streets.

Key words: green infrastructure, Yamalo-Nenets Autonomous District, street plantings, urban parks.

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RELATIONSHIP OF GROWTH AND THE GENETIC DIVERSITY LEVEL ACCORDING TO QUANTITATIVE CHARACTERISTICS OF TRUNKS OF PLUS PINE TREE CLONES

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Abstract. The patterns of growth and the relationship of the growth process with the level of genetic diversity were studied according to the quantitative characteristics of the vegetative offspring of the plus trees of common pine, represented as a part of the clone plantation, created in the Dyurtyulinsky Forestry of the forest-steppe zone of the Republic of Bashkortostan on the site with C_2 type of forest growing conditions in 2005. The compliance with the selection and genetic principle of phenotypic assessment of common pine clones, as well as with procedural and methodological requirements for conducting the field stage of the study, was ensured. The statistical evaluation of the growth of the species clones represented by 40 ramets was given. Four clones were separated (29, 136, 264 and 262) characterized by the best sizes of the diameter of trunks: ^{2}2.4±0.31 – 25.5±0.73 cm; the height: 10.5±0.30 – 11.2±0.16 m; the diameter of crown: 7.1±0.22 – 7.5±0.45 m; the length of crown: 8.2±0.37 – 10.5±0.27 m; the increment of trunk axial shoots: 0.44±0.02 – 0.45±0.02 m. These characteristics denote the specific character of their genotypes. Their quantity is 40 % of total number of the considered clones. The cluster analysis allowed to separate two accurately isolated clusters with the clones having distinctive features in variability of the analyzed indicators of trunks. Differences between clones in trunk characteristics were confirmed by corresponding regression equations and calculations of coefficients of narrow-sense heritability. The proportion of the influence of factors on the variability and distinctiveness of the growth indicators of the trunks of common pine clones was estimated according to the algorithms of N. A. Plokhinsky and D. U. Snedekor. The best genotypes of the offspring of plus trees of common pine identified in the clone bank are of high value in forest selective seed production.

Key words: common pine, plus tree, clone bank, heritability coefficient, trunk diameter, trunk height, crown diameter, crown length, axial shoot increment, dendrogram.

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THE PLANNING STRUCTURE OF COURTYARD SPACES IN THE AKADEMICHESKIY DISTRICT IN THE CITY OF YEKATERINBURG

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Abstract. The article deals with the results of a comprehensive analysis of the courtyard spaces in the Akademicheskiy district in the city of Yekaterinburg. The objects of study are courtyard spaces with typical planning structures for the new residential complexes. The assessment of open spaces has been carried out in three categories: environmental, functional, and aesthetic. In each category, several characteristic indicators have been obtained, expressed in points. The obtained results suggest that the greatest attention should be paid to the principles of environmental sustainability, parity of artificial and natural components, multifunctionality, as well as aesthetic principles of space formation when optimizing the studied courtyard spaces. An analysis of the plantings in the courtyard spaces has also been carried out. The presented tree and shrub species on most of the studied objects are plants from the main assortment. There are single specimens from the additional and limited assortments, which were introduced to diversify the composition and enhance the decorative effect of plantings. There are also perennial herbaceous flowering species and ornamental deciduous species. The following species predominate among woody shrubs: shiny cotoneaster (*Cotoneaster lucidus Schltdl*.), common lilac (*Syringa vulgaris* L.), Siberian crab apple (*Malus baccata* L.), Japanese spiraea (*Spiraea japonica* L.f.). All plantings are in good condition. However, most of them are young, so they do not fully perform their functions to protect the space from adverse environmental factors. But they stand out against the background of the lawn, set the shape of the space and color accents during the season, improving aesthetic perception.

Key words: courtyard landscaping, building type, residential complexes, courtyard space structure, courtyard space classification, open local spaces.

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DYNAMICS OF TAXATION INDICATORS OF MODAL ASPEN STANDS IN THE UDMURT REPUBLIC

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Abstract. The identification of the characteristics of growth and productivity of plantations is not only a theoretical basis for forestry, but also a basis for the development of forest conservation standards. Tables of the dynamics of taxation indicators of modal plantations can be used to compile regional tables of the growth process, which are used to determine the age of ripeness and solve many issues of forest management planning. The article revealed the dynamics of the areas and volumes of aspen growing stock on the basis of accounting of the forest fund of the Udmurt Republic in the period 2007–2022. Using the taxation descriptions of the Krasnogorsky, Seltinsky, and Uvinsky Forestries, the stratification of the allotments of the second quality class in the linden pine forest with the aspen in the stand composition of the tier from four units and above was carried out. The variability of taxation indicators in the range from 1.4 to 37.5 % was revealed. The regression analysis was applied to equalize the average height, diameter, relative density and growing stock. The adequacy of the models was assessed by the value of the correlation coefficient from 0.68 to 0.99. A comparative analysis of taxation indicators with regional tables of the growth rate of the corresponding forest area has been performed. No significant differences in heights and diameters were revealed, however, discrepancies in the limits of ± 11–50 % were observed in the stock, which was probably due to the density of modal aspen stands in the studied forest areas. The conducted research indicates the need to develop regression models of taxation indicators and build tables of height, diameter, and stock dynamics based on them, followed by calculation of growth tables reflecting the peculiarities of the development of stands.

Key words: forest fund, modal stands of aspen, variability and dynamics of taxation indicators, regression analysis.

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FOREST LITTER IN THE MIDDLE VOLGA REGION: FORMATION AND CLASSIFICATION POSITION

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Abstract. The study of the composition and properties of forest litter makes it possible to understand the ecology of functioning of forest biogeocenosis, the direction of soil formation processes. The purpose of the study is to determine the nature of the formation and qualification status of forest litter in the central regions of the Middle Volga region. The biogeocenological studies of spruce, fir, pine, larch, oak, linden, maple and birch forests in the southern regions of the Kirov region, the Mari El Republic and the Republic of Tatarstan were carried out. Morphological features, thickness, volume, physical and chemical properties of the forest litter have been revealed. The formation of biogeohorizon A0 is determined by the composition and structure of forest plantations, soil factors, and humidity conditions. The classification position of the litter of forest ecosystems in the Middle Volga region has been developed. The terms mull, moder, mor were used for the name of the types of biogeohorizon A0. The litter of the moder type was divided into subtypes: mull-moder, moder, mor-moder. The diagnostic parameters of the litter characteristics of dark coniferous biogeocenosis of the region were shown. In deciduous formations, the thickness of the forest litter varies on average within 1.0-3.4 cm, the volume ranges from 6.3 to 30.7 t/ha, these indicators are 1.7–3.4 cm and 9.9–28.5 t/ha for larch and fir forests respectively, they increase to 3.0–6.5 cm and 24.0–78.3 t/ha in pine forests, up to 4.0–8.5 cm and 37.4-95.6 t/ha in maturing and old spruce plantations. The litter of coniferous biogeocenosis is distinguished by relatively high acidity and the lowest saturation of bases. The highest accumulation of organic matter and actual acidity (pH = 4.0–5.0) in the biogeohorizon A0 were noted in the blueberry spruce forest and the cranberry-mossy pine forest. Changes in the age and density of the stand, in the composition and productivity of phytocenosis, alter the nature of the formation of the organic horizon A0. In forestry management it is reasonable to indicate the formation in which the forest litter is formed: oak strongly decomposed (mull), pine medium decomposed (moder), spruce roughly decomposed (mor).

Key words: Middle Volga region, coniferous and deciduous biogeocenosis, forest litter, formation, qualification position, properties.

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COMPARATIVE CHARACTERISTICS OF THE EFFECTIVENESS OF MAROPITANT AND METOCLOPRAMIDE IN DOGS WITH GASTROINTESTINAL TRACT PATHOLOGY

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Abstract. The main purpose of the research was to compare the effectiveness of gastritis therapy in dogs based on the drugs maropitant and metoclopramide. The study was conducted on the basis of the EuroVet veterinary clinic in the Penza region in 2021. The overall study group included 20 dogs that had the same weight category and body constitution, were in the same age group and had a similar clinical picture of dyspepsia. Polytherapy was performed for 14 days, each group of 10 dogs was given a different drug, and the dynamics of the disease process was recorded every 3 days. Saline solutions, multivitamin preparations and adsorbents were used in addition to these drugs. According to the research results, polytherapy based on maropitant proved to be more effective than on metoclopramide. The animals of the first group did not show the clinic of gastrointestinal pathology on the 10th day of treatment, and the animals of the second group - only on the 14th day. The exclusion of reflux from the symptoms of gastrointestinal pathology had a positive effect on the general condition of sick animals. The effectiveness of reflux induction is directly related to the content of dopamine in the blood: maropitant centrally blocks neurokinin-1 receptors, which leads to the cessation of the gag reflex, and metoclopramide only inhibits dopamine, which empirically showed less effectiveness. The analysis of hemodynamics on polytherapy showed that the physiological parameters of the formed blood elements returned to normal faster by 62.5% at average in the first group than in the second group of animals.

Key words: veterinary medicine, pharmacology, gastroenterology, dogs, maropitant, metoclopramide, therapy.

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Original article
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INCREASING THE RESISTANCE OF MINCED MEAT TO MICROBIOLOGICAL SPOILAGE BY THE USE OF A NEW ORGANIC PRESERVATION AGENT

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Abstract. Nowadays the Udmurt Republic does not have an independent industry of food additives production, and imported resources are limited, therefore, increasing the shelf life without losing the original qualities of the product is an urgent problem for the meat-processing segment of the region's industry. The effectiveness of using a new organic preservative agent based on acetic acid for the storage capacity of chilled minced semi-finished meat products has been studied. A dry laboratory sample of an organic preservative was used for the research. There were four model groups of semi-finished products in the experiment: the control group used a traditional production recipe without the addition of preservatives; experimental group 1 used a traditional recipe with the addition of a new preservative in an amount of 0.1 % on the weight of unsalted raw materials, experimental group 2 used a traditional recipe with the addition of a preservative in an amount of 0.5 % on the weight of unsalted raw materials, experimental group 3 used a traditional recipe with the addition of a preservative in an amount of 1.0 % on the weight of unsalted raw materials. Monitoring of microbiological parameters (the content of the total number of bacteria) was carried out on the 3rd, 6th, 8th, 10th and 12th days of storage of samples in refrigerated form according to generally accepted methods. Based on the analysis of organoleptic and microbiological indicators of experimental samples of chilled minced semi-finished meat, it was found that a preservative preparation based on acetic acid had better effectiveness in concentrations of 0.5 and 1.0 % on the weight of unsalted raw materials. The research results have established that according to organoleptic and microbiological characteristics the optimal shelf life of semi-finished minced meat with the addition of this preservative agent is 8 days (at 4±2 °*C*).

Key words: minced meat, contamination of meat raw materials, acetic acid, organoleptic parameters, microbiological parameters.

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AUTOMATED SYSTEM FOR ELIMINATING EMERGENCY DISCHARGES OF AGRICULTURAL ENTERPRISES

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Abstract. The aim of the work is to create a universal and scalable automated system for eliminating emergency discharges of various enterprises, including enterprises of agricultural business. The necessity of introducing additional taps from the main pipe with specialized filters for specific pollutants that may be found in the aquatic environment as a result of an emergency discharge of the enterprise is justified. The need to introduce additional taps with specialized filters at their outlet into the installation scheme is explained by the possibility of extending the service life of the main expensive cleaning filter, which, as a rule, is not designed to filter a number of emergency discharges. A damper valve rotating around its axis in the form of a cylindrical flow distributor located at the point where the pipe branches into four pipelines is used as the main mechanism for distributing liquid passing through the drain pipe. The measuring mechanism of the system uses optoelectronic sensors tuned to possible pollutants that may enter the aquatic environment from a particular enterprise. The installation offers the possibility to control automatically changes in the optical density of the aqueous medium flowing through the pipeline, and in case of contamination in the form of emergency discharges, change the position of the damper to drain contaminated water for additional filtration or into a storage. An algorithm and an electrical circuit of an automated system based on a microcontroller have been developed. This system reduces the risk of environmental pollution, extends the service life of a common expensive cleaning filter and reduces the degree of participation of service personnel in monitoring pollution in the wastewater system of the enterprise. Calculations have shown that the probability of applying unjustified environmental sanctions is reduced by 10 %, and the relative error of causing irreparable harm to the environment is reduced in half.

Key words: automated system, algorithm and operation program of the microcontroller, emergency discharges, optoelectronic sensors.

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Original article
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REGRESSION MODEL OF WEAR OF THE WORKING SURFACE OF BLADES OF THE DKR SERIES GRAIN CRUSHER DRUM

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Abstract. The development of agricultural production in Russia is associated with both dairy and meat livestock breeding. Nowadays an increasing share of the market in Russia is occupied by farms and large agricultural enterprises interested in new technologies, effective technical means capable of increasing the profitability of agricultural production. One of the promising areas is to reduce feed production costs, since they account for more than 60% of the cost of production of meat, milk and other livestock products. A large proportion of the productivity of cattle depends precisely on their quality. When preparing concentrated feed, agricultural enterprises widely use rotary-pneumatic hammer crushers, for example, crushers of the DKR series. This equipment has design and technological features as the axial loading of the working drum under the action of discharge in the feeding arm. It is the axial loading that is the main reason for the uneven distribution of the grain pile on the working surfaces of the drum, resulting in its uneven wear and a decrease in the durability of the blade wheel, which is the most time–consuming while restoring the crusher assembly. To solve the problem of intensive and extremely uneven wear of the drum wheel blades, it is necessary to study the destroyed working surfaces of the blades and develop a regression model of wear based on their residual thickness. Measurements of the residual thickness of the blades were carried out according to a standard technique using a MK-25 micrometer and an ICh-10 dial indicator at regular intervals along the inner contour, the middle section and the outer contour. The calculations have established the optimal angle of inclination of the blade β in various sections, which corresponds to 7° for the inner contour, 10.2° for the middle section and 13.5° for the outer contour. The regression analysis of the measurement results provides an opportunity to calculate the optimal location of the blades, which will ensure a close to uniform distribution of contact stresses on the wear surface.

Key words: grain crusher, regression model of wear, contact stresses, destruction of the blade wheel, crusher service life, optimization of the drum design, coefficient of normal contact stresses.

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METHODOLOGY AND RESULTS OF STUDY OF IMPACT INTERACTION OF THE TUBER MODEL WITH NODES OF A SCREEN CALIBRATING DEVICE

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Abstract. The potato tubers calibration into size fractions is an important operation before storing potatoes or when preparing them for sale or processing. Among many calibrating devices, screen devices stand out favorably due to the low energy consumption and high accuracy. One of the ways to increase their efficiency in terms of productivity and accuracy is the use of sieve drive mechanisms with modified laws of their motion (with several changes in the acceleration). However, an important condition for the safety of potatoes during storage is a low level of damage to tubers during placement for storage. The task is to develop a methodology for determining the impact on the potato tuber model by working elements of a screen calibrating device. This will allow to obtain an objective and instrumentally controlled picture of possible damage or sufficient protection from damage to tubers. A polyurethane element with an internal impact sensor is used as a model. The shock sensor allows you to send information via a radio channel to a receiver that can digitize and visualize the signal. The methods of calibration of the impact sensor and investigations of the impact interaction of the tuber model with parts of a screening device for potato calibration have been developed. A linear calibration curve was obtained, its equation with a high coefficient of determination was also obtained, and a confidence interval for calculating the impact force on the tuber was established after laboratory experiments. After testing the screen calibration device it was established that the impact force did not exceed $F = 75.39 \pm 14.83$ N or a range of 60.56...90.22 N. Taking into account the permissible value of the impact force of no more than 120 N, the damage tolerance requirements are not violated.

Key words: screen, calibrating device, tuber, pile, tuber model, impact sensor, calibration, confidence interval.

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THEORETICAL STUDIES OF THE EFFECT OF CERAMIC ANTIFRICTION COATINGS IN BEARING JOINTS ON DYNAMICS OF THE TURBOCHARGER ROTOR

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Abstract. Agricultural enterprises operate a large number of mobile and stationary energy vehicles equipped with diesel engines fitted with turbochargers. However, there is a problem of early rotor shaft failure due to abrasive wear. In most cases it is possible to restore the shaft by cladding with various materials. But the most interesting option is cladding of ceramic antifriction coating, as there is a significant reduction in the coefficient of friction in the interface with the plain bearing. On this basis, the main purpose of the research is to carry out a theoretical analysis of the effect of ceramic antifriction coatings in bearing joints on the dynamics of the turbocharger rotor. To implement this work the following tasks were set: identification of initial data for calculation, development of a mathematical model, calculation and analysis of results. The theoretical analysis involved the study of information sources on design and research of turbocharger parameters. Measurements of geometrical dimensions of elements of the rotor and its body were carried out. 3D-models were created and dynamic characteristics were investigated using the programs KOMPAS-3D and APM-Fem. A mathematical model describing the processes occurring in the turbocharger and influencing the dynamics of the rotor spinning was developed. The developed mathematical model is based on the action of Newton's second law. The results of calculations show that the use of the ceramic antifriction coatings can reduce the time of turbocharger rotor acceleration by 45% compared to the standard. This indicator allows us to conclude that the use of the ceramic antifriction coatings in the bearing interface will improve the efficiency of the turbocharger and the engine, reduce the startup time of steady-state operation of the turbocharger.

Key words: turbocharger, ceramic antifriction coatings, turbocharger rotor, mathematical modelling, rotor spinning dynamics.

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Original article
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ANALYSIS OF DESIGN FEATURES AND OPERATION MODES OF THE BIOGAS PLANT

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Abstract. The research purpose is to analyze the design features and operating modes of a biogas plant to increase the efficiency of the technological process of animal waste disposal. The research was carried out at the experimental site of the basic Department of Engineering Systems of Housing and Communal Services of Kalashnikov ISTU in 2023. The design of a two-section bioreactor and a general scheme of the operation stages of a biogas plant were developed. The technological process involved combining two modes of anaerobic fermentation into a single cycle – mesophilic and thermophilic. The mesophilic mode assumed the duration of the experiment for 5 days in the temperature range 30–35 °C, the thermophilic mode – for 10 days at the temperature of 50–53 °C, which was achieved by additional heating with a heat exchanger. The biogas formed as a result of fermentation enters the gas tank, and then the gas mixture is supplied for purification to the installation for complex gas treatment. An analysis of the results of experimental studies indicates that the optimal duration of the process of anaerobic fermentation of livestock waste in a 0.8 m3 bioreactor with the addition of a process activator in the thermophilic operation mode of a biogas plant was 10 days, the optimal concentration of biogas reached 5.78 %. The introduction of biogas plants at agricultural enterprises in the Udmurt Republic will allow to obtain an annual economic effect in the amount of 25,802 rubles for a peasant farm with 10 heads of cattle, using an energy-efficient three-stage technology for anaerobic fermentation of livestock waste and using a biogas plant in the waste treatment process, the payback period of the project will be 3.9 years.

Key words: biogas plant, mesophilic fermentation mode, thermophilic fermentation mode.
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Original article
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THEORETICAL STUDIES FOR SUBSTANTIATION OF THE CONNECTING ROD LENGTH OF THE AXIAL CRANK MECHANISM OF THE SEGMENT-FINGER MOWER

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Abstract. The article analyzes the operation of an eccentric crank mechanism for driving a knife of a mass-produced segment-finger mower when mowing natural grasses on slopes with complex and changing terrain of the field. The main disadvantages of the eccentric crank mechanism of the knife drive resulting from its dynamic imbalance were noted. To eliminate the disadvantages, an experimental mower with an axial arrangement of the crank mechanism on the finger bar of the cutting device was proposed, which allowed the finger bar to be transferred to the transport position in the operating mode of the cutting device, when bypassing obstacles in the form of shrubs, trees or rough irregularities. According to the results of experimental studies, it has been established that the cutting device in the process of copying the field relief changes the angle of inclination β relative to the horizon within ±15°. In this case, the value of the deaxial h varies from 0.281 m to 0.492 m. It is established that a change in the magnitude of the deaxil involves a change in the stroke, speed and acceleration of the knife. Using the analytical method of kinematic investigation of crank-rod mechanisms according to Artobolevsky in Excel, with the initial data of the crank radius of 38.1 mm and its rotation frequency of 1000 rpm, the following graphical dependencies were obtained characterizing the change in the acceleration of the knife in one revolution of the crank with a connecting rod length from 0.08 m to 0.46 m. When the connecting rod length decreases to less than 0.16 m in the crank position π, an abrupt and uneven change in the acceleration of the knife occurs. Such a change in the knife acceleration leads to an increase in the load in the connecting rod joints and affects negatively the operation of the entire crank mechanism. With an increase in the connecting rod length of more than 0.16 m, the phenomenon of fluctuations in the acceleration value is smoothed out.

Key words: segment-finger mower, deaxial, crank mechanism, cutting device.

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Original article
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INVESTIGATION OF EFFECT OF THE GEOMETRIC SHAPE OF HOLES IN A SEPARATING SIEVE ON OPERATION PARAMETERS OF A GRAIN HAMMER CRUSHER

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Abstract. The main technological operation in the production of combined feeds is grinding. For this purpose the open type hammer crushers are mainly used, in which the grinding and separation processes take place in different chambers. As a rule, punching sieves with round holes are used as separating surfaces. The most effective is the use of sieves with square holes having a free area ratio greater than that of sieves with round holes. The purpose of the research was to determine the regularities of the working process of a hammer grain crusher when using cyclone separators with different geometric shapes of the holes of separating sieves. To conduct a laboratory research the cyclone separator was manufactured with the possibility of replacing separating sieves with various geometric holes. Barley grains of the varieties Sonet, Raushan, wheat grains of the variety Iren were used as crushed grain. The research results found that in the case of using separating sieves with square holes, the increase of the grinding module was about 30 % in accordance with the grinding module for all groups of farm animals. The use of separating sieves with square holes made it possible to reduce specific energy consumption by 38 %. The studies of determining the flowability of crushed grain have shown that the throughput of the crusher hopper increases by 12 % when the angle of natural slope of the bulk grain material decreases from φ = 35...40° to φ = 30...35°. The obtained results of preliminary studies of the cyclone separator with punched

square holes indicate that the use of this type of sieves has a significant impact on the technological performance of the grain crusher and further research is required to determine the optimal design and technological parameters.

Key words: separating sieve, grinding module, hammer crusher, dirt.

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Original article

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PURIFICATION TECHNOLOGIES: INNOVATIONS AND SOLUTIONS

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Abstract. The main sources of pollution and clogging of the water area are insufficiently treated wastewater with chemical, animal and plant residues from industrial and processing enterprises, including food production. Pollutants entering water bodies cause the qualitative changes in water: in physical and chemical properties, composition, accumulating harmful substances and declining the ecological state. It is advisable to conduct wastewater disinfection at bacteriological purification stations with the subsequent use of purified water in the technological process, for example, in recycling water supply systems or in-plant water recycling systems in which the discharge of any water without treatment is excluded. The purpose of this work was to study the issues of improving the technology of wastewater treatment from food production based on elements of microbiology, their compliance with sanitary and epidemiological criteria and to determine directions for implementing solutions at processing enterprises. The research studied the process of cleaning wastewater from food production by the example of wastewater from processing plants. A block diagram was proposed, a biological stabilization module was developed and manufactured. During the module operation it was possible not only to restore the operation of a number of waste treatment facilities, but also to eliminate completely fungal infections of various degrees of complexity. These results launched a new direction for controlling the activity of fungous masses, and the prospects for the target application of fungous complexes. For example, the experimental small-sized two-stage lo-

calized station had the high results of the purification of dairy wastewater from a BOD contamination level of 2650 units to 20 units without the use of chemical coagulants and flocculants. This technological design will also resolve the issues of recycling water supply for vegetable processing and canning factories.

Key words: water, purification, wastewater, microbiology, bacteria, fungus, sample, pollutants, oxygen, source, system, object, technology, food production, structure, quality, safety.

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Original article

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EFFECT OF THE NOZZLE JET DIAMETER ON ARTIFICIAL RAIN STRUCTURE IN MULTITOWER SPRINKLING MACHINES

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Abstract. Modern sprinklers used as sources of artificial rain during the operation of multitower circular sprinkling machines have a damping system (pressure regulator) in their design. The regulator allows you to provide the required amount of pressure at its outlet, regardless of changes in pressure at its inlet due to hydraulic conditions, height differences and technological schemes for supplying water to the irrigated area. At a constant pressure value, the volumetric flow rate of water through the nozzle connected to the regulator by means of a threaded connection will be proportional to the square of the diameter of its nozzle. Considering that the flow rate for sprinklers with a cylindrical nozzle directly affects the volumetric geometric and energy characteristics of artificial rain, the correlation of the derivative of the flow rate associated with the diameter of the water jet at the outlet of the nozzle with these characteristics requires appropriate theoretical and practical studies. The purpose of the study is to formalize a mathematical description showing the effect of the nozzle jet diameter on the geometry of diameter-averaged spherical droplets moving along a ballistic trajectory from the edge of a rotating deflector into the surrounding air cloud. When determining the volumetric values of water flow at the nozzle outlet, the flow formula from Torricelli's

theorem was used, converted for practical calculations using catalog data of parameters of Nelson 3000 series sprinklers. This type of sprinklers was considered as an object of research with their operation tied to the main pipeline of a wide-reach circular sprinkler machine from the T-L Irrigation company. The proposed mathematical model for calculating the water flow rate at the nozzle outlet and an adapted method for determining a drop of average diameter in an air spherical cloud surrounding the sprinkler makes it possible to predict the height of irrigation in the irrigation plane of both a single sprinkler and a group of sprinklers, taking into account the location on the machine pipeline.

Key words: sprinkling machine, pipeline, pressure, flow, jet, nozzle, diameter.

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