Original article

CHARACTERISTICS OF SPRING COMMON WHEAT VARIETIES AISHA AND KINER

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Abstract. The extremely competitive market of spring common wheat seeds in Russia and the Republic of Tatarstan requires the creation of new competitive varieties characterized by high yields, the highest standards of grain quality and disease resistance under the changing weather conditions. The purpose of the study is to provide a comprehensive description of the varieties of spring common wheat Kiner and Aisha during their testing in the Tatar Scientific Research Institute of Agriculture (the applicant for a patent is FRC Kazan Scientific Center RAS). The studies were conducted on gray forest soil in the Pre-Kama zone of the Republic of Tatarstan in 2019-2023. The Yoldyz variety was the standard. It was found that the average yield of Aisha (3.49 t/ha) and Kiner (3.76 t/ha) was at the standard level (3.47 t/ha), however, the Kiner variety had a significantly higher protein yield of 0.47 t/ha than the standard of 0.38 t/ha. The Aisha and Kiner varieties had grains with a protein content of 13.7±1.5 % and 13.9±1.5 %, respectively, and gluten content of 24.9±3.3 % and 24.7±4.3 %, respectively, which meets the requirements of Class 2-3. The Kiner variety met the criteria of strong wheat in terms of dough resilience on the alveograph (P = 81-120 mm) and the P/L ratio (1.4–2.0). The Kiner variety is resistant to powdery mildew (6-8 points) and has an average resistance to brown leaf and stem rust (20 % damage in years of severe disease development), surpassing the standard and the Aisha variety in resistance to these diseases. Both types possess a range of economically significant traits that surpass the standard Yoldyz variety. This makes them highly promising for adoption in agricultural production in the Republic of Tatarstan and in other regions of Russia.

Key words: wheat, variety, yield, quality, disease resistance.

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Original article

CHANGES IN THE BIOLOGICAL ACTIVITY OF SOD-PODZOLIC SOILS WHEN APPLYING MICROBIOLOGICAL FERTILIZERS

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Abstract. Potato is a crucial crop in agriculture, and soil biology, though often overlooked in scientific discussions on the problems of crop technology improvement, is vital for maintaining fertility. It can enhance yields and product quality. The aim of this study was to identify the relationship between soil biological properties and the yield and quality of agricultural products over three years. The field trials were conducted in the experimental plot in Verkhnaya Talitsa, Votkinsky District, Udmurt Republic in 2022-2024; the vegetation studies were performed at the Department of Agrochemistry, Soil Science, and Chemistry of Udmurt State Agricultural University in 2024-2025. The results demonstrated a positive effect of a combined application of the microbiological fertilizers Azotovit and Phosphatovit on soil cellulolytic activity, on soil capacity of ammonification and nitrogen mineralization. The increase was 330 %, 381 %, and 72 %, respectively. During the field trials the application of Azotovit resulted in 17 % increase in potato yield and 10 % increase in dry matter content. A strong negative correlation was observed between soil cellulolytic activity and nitrogen content in tubers, with a correlation coefficient of -0.97.

Key words: potato, biological properties of soil, cellulolytic activity, nitrification, ammonification, microbiological fertilizers.

For citation: Karpova A. Y., Iudin V. A., Rudometova A. A. Changes in the biological activity of sod-podzolic soils when applying microbiological fertilizers. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 12-21. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_12-21.

Original article

COMPARATIVE EVALUATION OF INDUSTRIAL HEMP VARIETIES BY YIELD AND PRODUCT QUALITY IN THE MIDDLE PRE-URALS

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Abstract. Hemp is currently being applied in new innovative areas in various branches of the national economy. The choice of variety is one of the key factors affecting the productivity of industrial hemp. Therefore, the purpose of the study was to evaluate and identify the most productive hemp varieties when cultivated for dual use in the Middle Pre-Urals. The scientific experiments were carried out on sod medium-podzolic middle loamy soils with hemp varieties of Central Russian and Southern ecotypes: Nadezhda (standard), Vera, Rodnik, Seim, Surskaya and YUSO 31. The years of research varied in soil and meteorological conditions. On average for 2023 and 2024, the following varieties were predominant in terms of seed productivity – the Central Russian varieties Nadezhda - 134 g/m^2 and Surskaya - 129 g/m^2 with the corresponding fiber yield – 124 and 117 g/m^2. The yield of these varieties was provided with plant density before harvesting 71 and 73 pcs/m^2, the number of seeds on the plant 109 and 101 pcs., their weight 1.68 and 1.59 g, respectively. The studied hemp varieties had differences in the concentration of crude fat and protein in the seed crop over the years of the study. Under the conditions of the hyperarid and hot vegetation period of 2023, the seeds of hemp varieties accumulated more crude protein by 5.1-10.4 % than in 2024. On the contrary, under the conditions of vegetation period of 2024 with an abundance of precipitations, the crude fat content was more by 9.8-13.3 % than in 2023, or 144.1-159.6 % to the level of 2023. The Nadezhda variety had the largest harvest of crude oil of 378 kg/ha and protein of 186 kg/ha on average over two years of research. The Seim variety excelled in fiber content during the technology of cultivation for dual use in both years of research, the harvest of fiber content was 36.7 % in 2023, 43.3 % – in 2024. The Nadezhda variety, which was predominant in seed yield, had 33.2 % of fiber in 2023, 31.8 % in 2024. In terms of fiber accumulation in the stem, this variety was 3.5 % lower than the Seim variety in 2023 and 2.5–11.5 % lower than the other tested varieties in 2024.

Key words: hemp, seed yield, fiber yield, adaptability coefficient, crude fat content, crude protein content, fiber content.

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Original article

THE EFFECT OF DESICCANTS AND THEIR APPLICATION TIMING ON THE CONTAMINATION OF OAT SEEDS WITH FUSARIUM SPP. FUNGI

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Abstract. The article provides three-year data on the study of the impact of desiccants and the timing of their use on the Yakov oat seeds contamination with Fusarium spp. fungi. The field studies were carried out at the experimental field of the Iyulskoe training farm, and the laboratory studies were carried out at the Department of Crop Production of Izhevsk State Agricultural Academy. The soil of the experimental fields is sod medium-podzolic middle loamy, it is characterized by an average humus content (2.2-3.2 %). The reaction of soil medium is from weak to nearly neutral (pH 5.4-5.8), with an average and high content of labile phosphorus – middle and high (120-337.0 mg/kg) and high exchangeable potassium (162-270.3 mg/kg). Meteorological conditions during the years of research varied in temperature and precipitation. The growing season of 2015 was quite warm, but with excessive moisture. The growing season of 2016 was dry. July and August were hot and dry (Hydrothermal index = 0.8... 0.9). The hydrothermal conditions of 2017 were favorable to the growth and development of oats. The studies were carried out according to the following scheme: factor A – spraying plants with desiccants: A1 - without treatment (control); A2 – water treatment (control); A3 – Roundup, WS (dilute glyphosate 360 g/l) – (3 l/ha); A4 – Basta, (a.i. ammonium glufosinate 150 g/l) WS – (3 l/ha); A5 – Reglon Super, (dilute diquat 150 g/l) WS – (2 l/ha); factor B – treatment time: B1 – the first treatment period (milk-dough state of grain – control); B2 – the second treatment period (three days after the control); B3 – the third treatment period (six days after the control); B4 – the fourth treatment period (nine days after the control); B5 – the fifth treatment period (twelve days after the control). Fusarium spp. fungi were found in all studied oat seed samples in natural infectious background. The phytopathological analysis of the examined samples of chaffed oat seeds revealed that desiccation and weather conditions influenced the contamination of harvested seeds with Fusarium blight. On average for 2015-2017 the treatment of oat crops with Basta, Roundup and Reglon Super reduced the contamination of Yakov oat seeds to the level of 1.5-2.5 %. The experiments showed that chemical drying of oats with Reglon Super, Basta, and Roundup during the fourth treatment period yielded 5.15–5.34 t/ha on average for the period of 2015-2017.

Key words: oats, seeds, Fusarium blight, desiccants, timing, grain yield.

For citation: Pechnikova T. I., Kolesnikova V. G., Strot T. A., Lekontseva T. G. The effect of desiccants and their application timing on the contamination of oat seeds with Fusarium spp. fungi. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 30-37. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_30-37.

Original article

COMPARATIVE ASSESSMENT OF BIOSTIMULATORY ACTIVITY OF COLLAGEN HYDROLYZATES IN ADVENTITIOUS ROOTS FORMATION IN CUTTINGS OF PYRAMIDAL OSOKOREVY KAMYSHINSKY POPLAR

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Abstract. The article presents the results of studying the effect of a biostimulant from animal and fish collagen wastes on the rooting in cuttings of Pyramidal Osokorevy Kamyshinsky poplar. The collagen raw material was pretreated with NaOH to partially destroy it. Optimal concentrations of NaOH were determined for providing the necessary rate of collagen cleavage for subsequent fermentation of raw materials with the actinomycete Streptomyces fradiae AC – 570 culture. It has been established that an increase in the concentration of NaOH from 0.2 % to 0.8 % accelerates the hydrolysis of both types of collagen due to the active cleavage of peptide bonds. But the fish collagen is more sensitive to alkaline treatment and is more easily hydrolyzed. The degree of hydrolysis of the fish collagen was 1.8 – 2.1 times higher than that of the animal collagen. It was revealed that the enzymatic hydrolysis of fish collagen was more intensive after the alkali pretreatment. The degree of hydrolysis increased by an average of 24.9 % for animal collagen, and by 30.1 % for fish collagen. The fractional composition of collagen hydrolysates has shown that peptide fractions predominate in the animal hydrolysate, while amino acid fractions predominate in the fish hydrolysate. The tendency of the stimulating effect of peptide fractions of collagen hydrolysates on root formation in cuttings of the Pyramidal Osokorevy Kamyshinsky poplar has been revealed. Morphometric parameters of the cuttings of the Pyramidal Osokorevy Kamyshinsky poplar after their treatment with collagen hydrolysates were determined. The number of formed roots and the total root mass of cuttings treated with animal collagen hydrolysate were 1.8 times and 1.6 times greater than those of cuttings treated with fish collagen hydrolysate. The leaf biomass of the cuttings aged in animal collagen hydrolysate increased by 14.3 % compared to the fish collagen variant.

Key words: biostimulator for plants, collagen hydrolysate, rooting of cuttings, poplar, animal collagen, fish collagen.

For citation: Bryndina L. V., Repnikova L. A., Korchagina A. Yu., Zhivitchenko D. I. Comparative assessment of biostimulatory activity of collagen hydrolyzates in adventitious roots formation in cuttings of Pyramidal Osokorevy Kamyshinsky poplar. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 38-48. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_38-48.

Original article

MODELING THE RELATION BETWEEN THE DIAMETER OF TREES AT 1.3 M HEIGHT DEPENDING ON THE DIAMETER AND HEIGHT OF STUMPS FOR TREE SPECIES IN THE BRYANSK REGION

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Abstract. There are no reliable methods for assessing the volume of illegally cut timber at present. In some regions there are no tables for converting stump diameters to chest-height diameters, and the height of the stump is not taken into account. The authors developed the mathematical models for assessing tree diameters at 1.3 m height depending on the diameter and height of the stumps for the main forest forming species in the Bryansk region. To identify the patterns of the formation of the wood trunks of pine, spruce, birch, aspen, black alder and oak, the trial areas and circular sites were established where 20 inventory trees were measured by the main forest type. The studies were conducted in the Educational and Experimental Forestry in the Bryansk region. According to the methodology, the diameters of the inventory trees were measured at heights of 0.01 m; 0.1 m; 0.2 m; 0.3 m; 0.4 m; 0.5 m; and 1.3 m. The total number of inventory trees was 926. The data of changes in the tapering of tree trunks obtained during the study do not contradict, but rather confirm the known patterns of growth and development of tree vegetation, which have been established by taxation criteria for various forest zones in Russia. An additive model proposed by V. L. Chernykh and his colleagues was used to model the tapering of the tree roots. Models of the tapering of the tree basis in relative values of the main tree species have been obtained. Mathematical models have been developed for estimating the diameters of trees at 1.3 m height depending on the diameter and height of the stumps. The determination coefficient for the studied tree species is above 0.99. To estimate the volume of illegally cut wood in case of lacking a tree trunk, it is necessary to measure the diameter and height of the stump, and then apply the developed tables to convert these measurements to a diameter at a height of 1.3 m.

Key words: tree diameter at a height of 1.3 m, stump diameter, stump height, statistical indicators, tabulated values, relative diameter values.

For citation: Perepechina Yu. I., Strelkov S. S. Modeling the relation between the diameter of trees at 1.3 m height depending on the diameter and height of stumps for tree species in the Bryansk region. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 49-58. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_49-58.

Original article

VARIABILITY OF THE ANNUAL RINGS STRUCTURE IN SPRUCE STANDS IN YAGANSKY FORESTRY OF THE UDMURT REPUBLIC

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Abstract. In accordance with the research objective, the variability of the width of annual rings of spruce trees (*Picea abies L.*) in stands of different ages of the Yagansky Forestry of the Udmurt Republic was thoroughly assessed. The obtained data are important for understanding the processes of formation of radial growth and the quality of wood determined by the proportion of late wood. Wood cores were selected on the temporary sample plots established in accordance with the standard methodology, and the size of annual rings and the width of early and late wood over the past 10 years were determined. The correlation analysis was applied to reveal the relationship between the width of the annual ring and meteorological factors of the growing season (temperature and precipitation). It has been established that late wood is the most variable component of the annual ring, with a coefficient of variation up to 78 %. The total width of the annual ring has less variability. No statistically significant linear relationship between the width of early and late wood and the average temperature of the growing season has been found. A moderate positive correlation has been discovered between the amount of precipitation and the width of early wood. The relationship of precipitation with the width of late wood is insignificant, weak and negative. It should be noted that the correlation analysis revealed substantial differences across various sample areas. This highlights the intricate influence of external factors and underscores the importance of considering local soil, climate and cenotic factors when predicting the growth of woody plants.

Key words: spruce stands, sample plots, wood core, annual ring width, early and late wood, meteorological factors.

For citation: Pozdeev D. A. Variability of the annual rings structure in spruce stands in the Yagansky Forestry of the Udmurt Republic. *The Bulletin of Izhevsk State Agricultural Academy*. 2025; 4 (84): 58-65. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_58-65.

Original article

PHYSICAL PROPERTIES OF SOILS IN MAIN FOREST TYPES OF THE URAL EDUCATIONAL-EXPERIMENTAL FORESTRY

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Abstract. The article presents the results of studying the general physical properties of soil in the main types of forests within the mountain forest belt of the eastern Ural Mountains in the Ural educational-experimental forestry station of the Ural State Forestry Technical University. The soil pits were laid out on 11 trial areas with sampling by genetic horizons for laboratory analysis, as well as their monoliths for their utilization in the educational process in the following subjects: Soil Science, Forestry, Forest Management. The properties of the studied mountain soils are specific, characterized by a complex combination of podzol and brown soil formation. The prevalence of light granulometric composition of the studied soils reduces the processes of illuviation in sod-podzol varieties. It is not expressed in lithozems. The gravel content of profiles is different both in degree and depth of the soil profile. It is most pronounced in lithozems: up to 48 % at a depth of 14 cm. High porosity, exceeding 40 % of the soil volume, provides favorable water-air regime, good drainage conditions of soils and favorable conditions for forming forest types. The peat-gley soil of the geomorphological depression is characterized by heavy granulometric composition. The physical properties of this soil are unfavorable compared to those of other forest types. Nevertheless, they support the growth of a plant community of pine and spruce sedge-sphagnum. Wind resistance and water stability of soil aggregates of the studied soils are low and indicate the strict observance of erosion control measures on these soils, protection forests from fires and from unjustified cutting.

Key words: forest types, mountain soils, soil formation processes, soil physical properties, soil aggregate composition.

For citation: Senkova L. A., Abramova L. P., Lugansky V. N. Physical properties of soils in main forest types of the Ural educational-experimental forestry. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 66-74. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_66-74.

Original article

TYPOLOGICAL DIVERSITY OF MOUNTAIN FORESTS BY THE EXAMPLE OF ISSYK-KUL FORESTRY ENTERPRISE IN THE REPUBLIC OF KYRGYZSTAN

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Abstract. The Issyk-Kul forestry enterprise is one of the typical advanced enterprises of the Republic of Kyrgyzstan. The increasing intensity of anthropogenic pressure on forests in combination with climate aridization necessitates the improvement of forest management,

which can be provided only on the basis of precise data on the distribution of tree and shrub plantations by forest types. Using forest management data and the authors' research findings, the distribution of forested lands by forest types was analyzed. Recommendations for enhancing reforestation practices were also provided. It has been established that spruce forests, represented by Tien Shan spruce (Picea tianschanica Rupr.) or Schrenk's spruce (P. Schrenkiana F. et M.), predominate among tree plantations in the forestry enterprise, accounting for 51.0 % of the lands covered with forest vegetation. As for spruce forests, highland stands are particularly prevalent, covering 29.7 % of the forestry's total area and 58.2 % of all spruce plantations. The dominant species of all shrub plantations are humistratous juniper stands, occupying 5891.6 hectares or 30.4 % of the total forested lands. Proposals are given for improving reforestation in plantations of the main forest types, as well as for fire prevention and directions for further research.

Key words: the Republic of Kyrgyzstan, forest fund, tree plantations, shrub plantations, forest types.

For citation: Chyngozhoev N. M., Kubatbekov N. B., Zalesov S. V. Typological diversity of mountain forests by the example of Issyk-Kul forestry enterprise in the Republic of Kyrgyzstan. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 74-81. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_74-81.

Original article

EFFICIENCY OF USING A PROTEIN-CONTAINING FEED ADDITIVE BASED ON THE ENZYME SUPEROXIDE DISMUTASE IN BEEKEEPING

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Abstract. The application of organic stimulating feed additives in beekeeping is currently quite popular and relevant. The chemotherapeutic agents for treating and preventing bee diseases weaken honey bees' immune systems, reducing their summer activity and the productivity of bee colonies. During the testing a feed additive based on the antioxidant enzyme superoxide dismutase of the foreign and domestic production, the following indicators were examined: the development of bee colonies, their honey productivity and the economic efficiency of using the additives. The studies were conducted in an apiary located in the Mozhginsky District of the Udmurt Republic. The comparative analysis has shown that the use of a stimulating additive has a beneficial effect on the growth dynamics of bee colonies in comparison with the control groups. The experimental group 2 had the maximum indicators in brood quantity up to 304 hundred cells with the application of the imported enzyme, the application of the domestic analogue with the addition of rosehip infusion resulted in 342.2

hundred cells in the experimental group 3. The level of honey commercial productivity in these experimental groups was 37.3 kg and 41.1 kg, respectively. The level of profitability was 42.8 % in the experimental group 2, and 58.1 % - in the experimental group 3.

Key words: beekeeping, feed additive, brood, honey productivity, profitability, enzyme, superoxide dismutase.

For citation: Vorobyova S. L., Fedorova A. S., Vasilyeva M. I. Efficiency of using a protein-containing feed additive based on the enzyme superoxide dismutase in beekeeping. *The Bulletin of Izhevsk State Agricultural Academy*. 2025; 4 (84): 82-88. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_82-88.

Original article

THE PRODUCTIVE LONGEVITY OF DAUGHTERS FROM FOREIGN AND DOMESTIC BREEDING BULLS UNDER VARIOUS MANAGEMENT TECHNOLOGIES

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Abstract. Under the modern conditions of intensification in dairy cattle breeding, the long-term profitability depends on extending the productive lifespan of cows. The long-term economic use of cattle provides the possibility to distribute the growing and keeping costs, which significantly increases the economic efficiency of milk production. The essential factor in solving this problem is the directed breeding of servicing bulls, whose daughters should excel in milk yields and possess robust health, strong reproductive capabilities, disease resistance; all these traits determine the capacity for the long-term economic use. The research was conducted in the breeding farm of the Udmurtia APC in Vavozhsky district of the Udmurt Republic. We analyzed 822 cows, the daughters of 14 sires. To assess productive longevity the following indicators were used: age in months, age in lactations, total milk output, average fat and protein content in milk. The research results have revealed that employing foreign breeding bulls can extend the productive lifespan of their daughters by 0.7 lactations under the loose keeping technology and by 0.6 lactations with tethered systems. However, despite the age difference, the average milk production in daughters differs slightly, as the milk yield for the first lactation is almost identical for all groups (9,380-9,590 kg), with a slight advantage in case of the loose method of keeping. The daughters of foreign bulls produce a slightly higher lifetime milk yield (27,809 kg) compared to those from domestic bulls (27,579 kg). The lifetime milk yield is 27,379 kg for foreign lines, while for domestic lines it is only 25,626 kg. The cows from foreign bulls produce more milk on average over their lifetime despite the

lower number of lactations. This may be due to higher sustainable productivity during the first few lactation periods. The fat content is significantly higher with a tethered method of keeping (4.19-4.20 %) than with loose keeping (4.01 %), regardless of origin.

Key words: productive longevity, servicing bulls, breeding, management technology, tethered keeping, loose keeping, dairy cattle breeding, lifetime productivity.

For citation: Zaika D. S., Yudin V. M., Tronina A. S., Manurov I. M. The productive longevity of daughters from foreign and domestic breeding bulls under various management technologies. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 88-96. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_88-96.

Original article

EXPERIENCE IN TREATMENT OF CLINICAL MASTITIS WITH VARIOUS APPROACHES

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Abstract. The mammary gland inflammation with various symptoms is the most frequently diagnosed disease of all cattle ailments. Clinical mastitis poses significant economic challenges for the farm, draining resources through treatment costs and reducing profits. Therefore, effective treatment methods are being developed annually. Timely diagnosis of all forms of mastitis is also crucial when identifying mastitis. The aim of this study was to identify the most effective therapeutic methods for clinical mastitis, depending on the severity of symptoms, in the farm in the Udmurt Republic. The objectives of the study were to formulate treatment plans based on mammary gland examination results, evaluate the effectiveness of pharmacological therapy, and determine the most optimal treatment regimens depending on the clinical presentation. For this purpose, groups of animals were formed based on the principle of analogous pairs with identical disease manifestations and physiological status. The animals were selected into the experimental groups according to the clinical presentation and the treatment regimen used. The study results have shown that the most effective method is the use of antibacterial drugs in combination with non-steroidal anti-inflammatory drugs. For cows with udder lesions affecting one to three lobes, the efficacy was 100 %, and for those with four lobes, the efficacy was 66 %. The study results also demonstrate that it is possible to use therapeutic regimens avoiding antibacterial and non-steroidal anti-inflammatory drugs.

Key words: cows, mammary gland, clinical mastitis, mastitis treatment.

For citation: Ilyina A. N. Experience in treatment of clinical mastitis with various approaches. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 96-103. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_96-103.

Original article

IMPLEMENTATION OF GENOMIC PREDICTION FOR MILK PRODUCTIVITY OF HOLSTEIN SIRES BY THEIR DAUGHTERS UNDER VARIOUS TECHNOLOGICAL CONDITIONS

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Abstract. Improving methods for the evaluation of breeding qualities of sires is essential in breeding programs aimed at increasing dairy cattle productivity. The implementation of the genetic potential of sires under different milking technologies is an urgent issue today. The objective of this study was to determine the implementation of the genomic prediction for milk productivity of Holstein sires by their daughters under different milking technologies. The study was conducted in Udmurtia APC in the Vavozhsky District of the Udmurt Republic. The groups of first-calf cows were formed depending on their origin and milking technology. The daughters of five sires were included in the study. In most cases, the genomic evaluation of sires under specific farm conditions is not fully confirmed. The analysis has shown that the actual milk productivity indicators of the daughters from sires with a high genomic evaluation are better than those of their herdmates from bulls with a lower genomic evaluation for milk productivity. When selecting bulls, the productivity level of cows in a specific herd should be taken into account. An analysis of the actual milk productivity indicators of cows compared to the average indicators of their herdmates and the genomic prediction of their sires with different milking technologies showed that the cows milked with the airyRobotR9500 milking robot from GEAWestfalia had the maximum milk yield over 305 days of the first lactation (9231.9 kg of milk) and achieved the fulfillment of the genomic prediction of milk productivity of the sires. The fat content in milk of cows milked with a milking robot is minimal and amounts to 3.52 %, which is significantly lower compared to this indicator for cows milked in other milking units. The protein content in milk of cows milked with different types of milking units differs slightly and ranges from 3.21 % to 3.29 %.

Key words: sires, genomic evaluation, milk productivity, milking technology.

For citation: Isupova Yu. V., Kislyakova E. M., Azimova G. V. Implementation of genomic prediction for milk productivity of Holstein sires by their daughters under various technological conditions. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 103-110. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_103-110.

Original article

MANIFESTATION OF BRACHYCEPHALIC SYNDROME DEPENDING ON THE DEGREE OF BRACHYCEPHALIC SOMATOTYPE IN DOGS

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Abstract. The study aimed to determine the possibility of maintaining the breed characteristics in dogs with moderate brachycephaly, without clinical signs of brachycephalic syndrome and with a normal respiratory function. The study included 38 brachycephalic dogs (14 pugs, 16 French bulldogs, and 8 English bulldogs) admitted to a veterinary clinic between January 2023 and May 2025. The control group consisted of 20 mesocephalic dogs of comparable size and age. All dogs had a comprehensive examination, including clinical examination, morphometric measurements (CFR, CI, NGR), radiography, computed tomography (n=20), endoscopic examination (n=15), and histological examination of soft palate biopsies (n=12). When examining the soft palate's structure, the data were compared with those from 9 control animals of mesocephalic breeds. Exercise tests and oxygen saturation checks were conducted before and after physical activity to evaluate the respiratory system's performance. The study of morphometric characteristics revealed distinctive geographical traits in the examined brachycephalic breeds, contrasting with the findings from other researchers. These features were presumably associated with the relatively small number of individuals of these breeds bred in the studied region, with the possible actualization of manifestations of the brachycephalic somatotype under conditions of possible inbreeding. The main findings suggest that dogs with moderate brachycephaly can retain their breed traits if they do not exhibit clinical signs of brachycephalic syndrome and have a normal respiratory function. However, the reliability of these findings should be verified through extended long-term research on broad samples. Thus, the balance between breeding work and animal welfare is achieved through careful, well-founded selection and monitoring.

Key words: brachycephaly, BOAS, dog health, breeding, functional respiratory function, morphometry, balance of breed characteristics and health.

For citation: Ostroukhov D. A., Vasiliev Yu. G., Khamitova L. F. Manifestation of brachycephalic syndrome depending on the degree of brachycephalic somatotype in dogs. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 111-118. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_111-118.

Original article

THE IMPACT OF SPENT OYSTER MUSHROOM SUBSTRATE (PLEUROTUS OSTREATUS) ON THE RATION DIGESTIBILITY IN RAMS

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Abstract. The purpose of the research was to study the influence of spent wheat oyster mushroom substrate on the feed digestibility in rams. The physiological experiment on rams was carried out according to the generally accepted methods in the ram stable Belogorka. Zootechnical, physiological and biochemical parameters of blood and the rumen content were studied in the digestion experiment on rams. This experiment examined the nutritional value of spent wheat substrate used to grow oyster mushrooms (growing the mushroom for 60 days). To conduct the digestion experiment, two groups of animals were formed, three heads in each group. In the first group of animals (control), the ration consisted of 1.5 kg of hay, 0.3 kg of concentrates (barley), in the second (experimental) group – 1.2 kg of hay, 1.0 kg of spent substrate, 0.3 kg of concentrates. The experiment consisted of two periods: preliminary, lasting for 19 days and accounting – for 6 days. The chemical analysis (substrates, feed, feces) was carried out according to the methods of mass analysis of feed and GOSTs. The alkaline reserve, hemoglobin, and erythrocyte levels in the blood were measured using a photometric technique. Additionally, total lipids, cholesterol, protein, lysozyme, and bactericidal activity were assessed. Protein fractions in serum were determined by C paper electrophoresis. At the end of the experiment, the ruminal fluid was taken from the tested animals, followed by determination of its ammonia content, cellulase and amylase activity (%). A study of sheep blood has shown that feeding with spent substrate in the ration increases the alkaline reserve of blood, the bactericidal activity of blood serum, and total protein within the physiological norm. Feeding rams with one kilogram of spent wheat substrate used to grow oyster mushrooms contributes to the increase of the digestibility of all nutrients: dry matter by 7.4 %, organic matter – by 7.5 %, crude protein – by 7.8 %, crude fiber – by 6.4 %, crude fat – by 17.8 %, nitrogen free extracts – by 8.9 %. Replacing 300 grams of hay with 1 kg of spent substrate with natural moisture in the ration of rams in the digestion experiment increased the use of calcium by 1.6 times, phosphorus by 2.4 times. The findings suggest the potential of using native spent oyster mushroom substrate as a feeding additive for ruminants, as it is rich in biologically active compounds.

Key words: spent wheat oyster mushroom substrate, mycelium of oyster mushroom, digestion experiment, use of calcium and phosphorus in the ration of rams, digestibility coefficients.

For citation: Savenko Yu. P., Alekseeva E. I. The impact of spent oyster mushroom substrate (Pleurotus ostreatus) on the ration digestibility in rams. *The Bulletin of Izhevsk State*

Agricultural Academy. 2025; 4 (84): 118-126. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_118-126.

Original article

COMPARATIVE ANALYSIS OF BROILER CHICKEN PRODUCTIVITY IN PRIVATE FARMS OF THE PERM REGION

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Abstract. In recent years, poultry farming in the Perm Region has been rapidly developing, with egg-type chickens dominating the industry. At the same time, the share of private households engaged in meat and poultry farming is increasing annually. Several enterprises in the area specialize in raising young poultry for local consumption. Both domestic and imported eggs are incubated in these organizations. The purpose of the research was to analyze the livability and productivity of COBB-500 cross broiler chickens from the Czech Republic and Spain under the conditions of household farms in the Perm Region. The study was conducted by analyzing data on the rearing, fattening and livability of Cobb-500 broiler chickens of different origins under identical conditions of keeping and feeding in three private households. It has been established that broiler chickens of the Cobb-500 cross from the Czech Republic raised for meat have the greater economic efficiency. Their livability was 95.33 % compared to the young poultry from Spanish eggs – 91.33 %. The analysis of the economic efficiency of poultry meat production reveals that birds hatched from Czech eggs are 8.48 % more profitable than those from Spanish eggs.

Key words: broiler chickens, COBB-500 cross, private households, livability, imported eggs.

For citation: Khokhlov V. V., Yudin V. M., Tronina A. S., Sitnikov V. A. Comparative analysis of broiler chicken productivity in private farms of the Perm Region. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 126-131. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_126-131.

Original article

HISTOSTRUCTURE OF THE THORACIC AORTA WALL IN RHESUS MONKEYS

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Abstract. The comprehensive histological and histochemical studies were performed on the thoracic aorta wall from 36 adult rhesus macaques (Macaca mulatta), male and female, who died from diseases unrelated to cardiovascular disease. The thickest section of the thoracic aortic wall in rhesus macaque monkeys is found on the dorsal side. The histotopographic feature of the intima is the orientation of the vessels of the microcirculatory bed. The intima is separated from the media by the internal elastic membrane and a change in the direction of the bundles of smooth myocytes. Collagen and elastic fibers within the intima create an internal elastic membrane, arranged in four to five layers. The wavy pattern of layers of connective and muscle tissue in the media is formed due to the shortening of elastic fibers during contraction of the smooth muscle sarcoplasm. A decrease in undulation toward the adventitia indicates the weakening of the muscle tissue's contractile ability in that region, which is crucial for protecting the tissues surrounding the artery wall. There are no acidic proteins in the structures of the thoracic aortic wall. Acidic glycosaminoglycans are localized in greater quantities in the inner elastic membrane and between the layers of fibrous structures, and the maximum amount is found in the endothelium and its basement membrane, that is, in the areas of greatest stretching of the aortic wall and its narrowing during the passage of a pulse wave. Cholesterol, fat, and fat-like substances were detected only in the intima. We did not find fenestrated plates with elastic fibers interwoven into them in the structures of the thoracic aortic wall, as well as spirally arranged collagen and muscle fibers in adventitia in rhesus monkeys.

Key words: histostructure, histochemical characteristics, aorta, rhesus macaque.

For citation: Shestakov V. A., Kolesnik Yu. A., Shcherbak N. V., Bulgin D. V. Histostructure of the thoracic aorta wall in rhesus monkeys. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 131-139. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_131-139.

Original article

DEVELOPMENT OF THE AUTOMATIC CONTROL AND MANAGEMENT UNIT FOR A LASER POLARISCOPE

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Abstract. The research purpose is to develop an automatic control unit for a laser polariscope with high resolution and efficiency for conducting computational and design tasks involving optically transparent models of parts. An optical device, a laser polariscope has been developed at the Udmurt State Agricultural University. It calculates contact stresses providing precise measurements. After statistical analysis, the contact stresses are expressed as polynomials in the sixth power $\sigma_к = \sum_{i=0}^{6} a_i x^i$ (regression equations). This is sufficient to accurately define boundary conditions when solving a plane (two-dimensional) problem using trigonometric series. To automate the control system of the optical device, it is necessary to choose an appropriate component base and design an electrical circuit. The LP-1 laser polariscope is mounted on a coordinate device which shifts the laser beam in relation to the transparent model in two coordinates. The polariscope design enables the synchronous rotation of both the polarizer and the analyzer. Stepper motors are used to move the coordinate device in two coordinates and ensure synchronous rotation of the polarizer and analyzer. Stepper motors require specialized controllers (drivers) to function. These drivers produce a series of pulses at a specific frequency, controlling the motor's movement. They convert control signals from a microcontroller or PC into the power current pulses necessary for the motor to operate. The developed circuit, utilizing the BE 1105 controller and DM 542 drivers, allows for precise control of the rotational speed of the stepper motor shafts by changing the magnitude of the resistance moments; it prevents missed steps without feedback and mitigates resonant issues; it has low power consumption. The tests of the control unit have shown high reliability of the electric drive of the laser device (the dynamic safety factor is close to 6) and the accuracy of studies of the stress state in models of parts of complex shape (the discretization of linear movement of the coordinate device is 3.1 microns). Laboratory studies demonstrate that the developed device with an automatic control and management system provides the opportunity to increase the productivity at the stage of designing new products for the agro-industrial complex by at least 3.5 times.

Key words: automatic polariscope control, laser polariscope, physical stress simulation, stepper motor, stepper motor controller and driver.

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Original article

DETERMINATION OF LIGHTING CHARACTERISTICS OF PHYTOTRON LIGHTING EQUIPMENT

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Abstract. For the cultivation of various plant species, special parameters of artificial lighting are required, therefore, it is crucial to accurately measure the lighting characteristics of the equipment used. When developing a phytotron, understanding these characteristics allows for more precise control over plant growth conditions, including fine-tuning the spectrum of photosynthetical active radiation. The purpose of the study is to determine the lighting characteristics of the equipment essential for developing a phytotron. The characteristics were determined using previously developed methodology. This approach involves collecting the primary features of the equipment, taking measurements with a luxmeter, and finally processing the obtained data. The result of the research is the spectral profile of the phytolamp. The findings of the study included the derived functions of the spectral characteristics for the luxmeter, for the lighting equipment, and for the spectrum of light perception by plants. An experiment was conducted to measure illumination from lighting equipment using a luxmeter. After processing the experimental data, the lighting properties of the applied phytolamps were determined. We designed the spectral characteristic of lighting systems on the basis of these features and determined the coefficients of light exposure for plants based on photosynthetical active radiation. The spectra from theoretical and experimental methods were compared, resulting in calculation of the maximum error of 8.11 % and the average error of 0.13 %. This level of errors is accepted as satisfactory for further development of the device. The result of comparing the obtained values with the measured spectrum proves the possibility of using the developed method for determining the lighting characteristics of artificial lighting equipment. The obtained analytical expressions for the spectral characteristics of the color channels of the lighting equipment will be used to regulate the light spectrum.

Key words: lighting characteristics, phytotron, lighting spectrum, LED strip, plant lighting.

For citation: Gusennikov E. N., Yuran S. I. Determination of lighting characteristics of phytotron lighting equipment. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 147-156. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_147-156.

Original article

ON THE DEVELOPMENT OF A COORDINATE TABLE DRIVE FOR AUTOMATIC CONTROL OF A LASER POLARISCOPE

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Abstract. The design and manufacture of modern agricultural machinery is becoming an increasingly science-intensive task. It is necessary to develop new methods and approaches to the creating structures with exceptional operational efficiency. For example, physical modeling techniques are becoming more widely employed to validate reliability indicators during the design phase of new structures. These methods allow for accelerated testing of individual components and technical systems using models based on principles of the similarity theory, which reduces the cost and time required for product design. One of the modeling methods is the optical study of the stress state to substantiate the strength reliability in the joints of machine parts. The article considers the calculation and development of the electric drive elements of the optical module actuator of the laser polariscope for studying the stress state on the models of joints in various parts of agricultural machinery. The main unit of the installation is the optical-mechanical device, which consists of a laser module, a coordinate table, stepper motors for rotating the polarizer, the analyzer, and a photodetector. The calculation of the holding torque, which is equal to 0.054 N·m, allowed us to select a NEMA 17 42 NM 40-2004 stepper motor for moving the coordinate table of the laser module. The dynamic load capacity of the motor exceeds 5.9, which is sufficient to protect it from accidental braking. The calculated angular velocity of the motor (30 rad/s) makes it possible to select the time required for one step of the motor, the frequency applied to the motor, and the number of pulses required for one rotation when developing an automatic control system. The stepper motor drive can provide high resolution in areas with complex stress concentrations due to the 3 μm discretization of the laser module's movement.

Key words: automatic control of the device, stepper motor, laser polari-scope, physical model, stress state.

For citation: Dorodov P. V., Kiselyov M. M., Gavrilov R. I., Petrov V. A. On the development of a coordinate table drive for automatic control of a laser polariscope. *The Bulletin of Izhevsk State Agricultural Academy*. 2025; 4 (84): 157-163. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_157-163.

Original article

TECHNOLOGY OF APPLYING THIN RESTORATIVE COATINGS BY LASER CLADDING

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Abstract. Wear limits for 48 % of machine parts are reached at wear values less than 0.1 mm. Traditional restoration processes produce coating thicknesses greater than 0.5 mm, which increases restoration costs caused by the expensive machining. The properties of restoration coatings are limited due to the use of standard metal alloys as filler materials. The purpose of the research is to implement a combined technology for building a restorative coating using traditional laser surfacing technology, followed by hardening the restorative coating with a ceramic layer. The first stage of this combined technology involves applying a restoration layer to the worn surface using traditional laser cladding with Np-55 filler wire. The second stage involves hardening the restoration layer using high-speed laser cladding of a ceramic composite based on boron carbonitride. Pulsed laser radiation generated by a BULATLRS-300 laser system is used to form the restoration layer. Cladding is performed in an argon shielding gas environment. The coating quality was assessed by optical analysis using the Olympus GX53 inverted microscope. The restoration coating analysis revealed a thickness of 150 μm, with the hardened layer being 8 μm. The restoration coating exhibits high density and satisfactory adhesion to the part surface and the ceramic layer.

Key words: restorative coating, high-speed laser cladding, ceramic composite, combined technology.

For citation: Ipatov A. G., Shmykov S. N. Technology of applying thin restorative coatings by laser cladding. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 163-168. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_163-168.

Original article

DEVELOPMENT OF A CONVECTION APIARY DRYER FOR HIVE FRAMES

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Abstract. The development of new efficient units for drying beekeeping products increases the efficiency and profitability in beekeeping. The purpose of the research was to

develop and test a new convection apiary dryer, designed for drying wooden hive frames and beekeeping products. The design of the developed dryer allows for cyclic operation, recycling the drying agent within the chamber and then expelling moist air into the atmosphere. The design is based on an air-pumping system consisting of a tangential fan, a diffuser, and a heating element (heating coil) mounted on a removable frame. The automatic control unit of the apiary dryer is based on an Arduino controller, which activates the heating coil and fan using electromagnetic relays. The air humidity inside the drying chamber was measured using two DHT 11 sensors placed at the bottom and top of the drying chamber, and the signals were transmitted to the Arduino controller. During the experiment, equal intervals of air heating time were selected, each lasting 15 minutes, and the intervals of air release from the drying chamber were set at 2 minutes. The total drying time for the experimental batch of hive frames was 52 minutes. The average initial moisture of the frames was 22.0 %. The average final moisture content of the frames at the end of the drying process was 9.8 %, which meets the requirements of the National State Standard – GOST 16588-91 "Sawn timber and wooden parts. Methods for determining moisture" and allows for the storage of frames in a warehouse. Frames dried unevenly during the tests, with variations not exceeding 10 %. The average power consumption of the dryer was 980 watt-hour. Thirty-millimeter-thick extruded polystyrene foam, attached to the chamber wall with the adhesive, served as the thermal insulation for the outer casing. The research results have revealed that the innovative apiary dryer effectively dries wooden hive frames removed from a steam wax extractor, preparing them for storage at a rate of up to 10 frames per hour.

Key words: beekeeping, apiary dryer, drying of beekeeping products, hive frames, Arduino controller.

For citation: Maksimov N. M., Popov A. V. Development of a convection apiary dryer for hive frames. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 169-178. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_169-178.

Original article

MANUFACTURING TECHNOLOGY OF PRIMERA DMC 9000 SEEDER COULTERS AND THEIR WEAR RESISTANCE EVALUATION

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Abstract. The research aims to substitute the imported Primera DMC 9000 seeder coulter with a domestic alternative, while maintaining its wear resistance and operational life. The article describes two directions for the manufacture of coulters based on research data and

field tests in 2024 and 2025. The first direction is the manufacture of coulters from rolled steel (65G steel) by laser cutting with surface hardening of the working surface. The second approach focuses on producing coulters with a welded pad on the front working surface, using the wear-resistant T-590 electrode with a sormite content. Field tests were carried out on the machine-tractor unit consisting of the K-744 Kirovetz wheeled tractor and the Primera DMC 9000 seeder in the Agricultural Production Cooperative Zarya in the Mozhginsky district of the Udmurt Republic. The tests were also conducted on the machine-tractor unit consisting of the Belarus-3023 wheeled tractor and the Primera DMC 9000 seeder in the Agricultural Production Cooperative Luch in the Vavozhsky district of the Udmurt Republic. The control operating time for one seeder was 500 ha. The research results have established that worn coulters lead to increased tractive resistance and higher fuel consumption. We have obtained the following data on weight and linear wear: the operating life of coulters made with a deposited layer of T-590 electrodes is higher than that of coulters made with surface hardening. Both the frontal surface of the shoe and the lateral thickenings are subjected to wear, and with varying intensity. The wear of the coulter point increases tractive resistance and fuel consumption. The wear of the side surfaces and their thickenings alters the parameters of the seedbed for covering seeds. Specifically, the width of the sowing strip narrows, impacting the quality of fertilizers and chemicals. This, in turn, reduces crop yields. The wear of the front surface of the coulter located above the wear-resistant plate leads to overloading of the plant material and disruption of parameters of seed covering.

Key words: seeder; hoe coulter; operational life; operating time; soldering.

For citation: Pervushin V. F., Ipatov A. G., Kostin A. V., Kasimov N. G., Salimzyanov M. Z. Manufacturing technology of Primera DMC 9000 seeder coulters and their wear resistance evaluation. *The Bulletin of Izhevsk State Agricultural Academy.* 2025; 4 (84): 178-184. (In Russ.). https://doi.org/10.48012/1817-5457_2025_4_178-184.

Original article

TECHNOLOGICAL SCHEME FOR COMBINED FEED PRODUCTION IN FEED PROCESSING BUILDINGS

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Abstract. To enhance animal husbandry efficiency, it is necessary to make full use of local feed resources and produce the maximum amount of combined feed ingredients on our own enterprises. The purpose of the research is to provide the rationale for the technological scheme of the production of protein-mineral-vitamin and mineral-vitamin supplements. The experimental studies were conducted in the laboratory of the Udmurt State Agricultural University in order to determine the optimal method of supplying ingredients into the mixer.

These studies aimed to determine the homogeneity of the mixture using different methods of supplying the components to be mixed. Barley and triticale grains were used as the mixed ingredients. The equivalent diameter of barley grains was 4.53 mm, of triticale grains – 6.87 mm. The grain moisture was 15...16 %, the bulk weight of barley grains was 600 kg/m^3, the bulk weight of triticale grains was 760 kg/m^3. The research findings indicate that a continuous supply of components, compared to a batch approach, can enhance the uniformity of the mixture by over 5 %. The proposed technology for creating combined feeds enables the production of complete feed mixtures using local raw materials. The calculation of the annual demand for components for the production of own protein-mineral-vitamin supplements has shown that about 600 tons are required for a farm with 1,000 animals. The average cost of oilcake production in the farms of the region engaged in the production of oilseeds is about 15 rubles/kg. The cost of soybean cake on the market of the Udmurt Republic fluctuated at the level of 45 ...50 rubles/kg in September 2025. Therefore, the annual saving in the production of the own protein components for the year is about 21 million rubles.

Key words: protein-mineral-vitamin supplements, mineral-vitamin supplements, combined feed, technological line.

For citation: Fedorov O. S., Shirobokov V. I., Dorodov P. V. Technological scheme for combined feed production in feed processing buildings. *The Bulletin of Izhevsk State Agricultural Academy*. 2025. № 4(84). С. 184-191. https://doi.org/10.48012/1817-5457_2025_4_184-191.