

COMPARATIVE ASSESSMENT OF WINTER TRITICALE VARIETIES

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Abstract. The crucial aspect of cultivation technology is the variety, which has a significant impact on the crop productivity. The winter triticale is a multipurpose crop that is highly adaptable to different growing conditions. The purpose of this study is to assess the varieties of winter triticale on the basis of economic traits under the soil and climatic conditions of the Middle Cis-Urals. The field experiments were conducted on sod-podzolic medium-loamy soils with an average state of cultivation. The experimental design included 7 varieties from the Rostov, Kursk, and Moscow regions, the Krasnodar Territory, and two standards: the regional varieties Izhevskaya 2 and Beta. The standards, as well as the Alatyrskaya variety, were characterized by greater winter hardiness (3.6 points). The Pakhar and Alatyrskaya 75 varieties had a lower degree of snow mold damage (53 %), while the Bemol 20 and Gleb varieties had a low degree of brown rust damage (no more than 27 %) during the growing season. The lodging of crops took place under wet growing conditions, the absolute resistance (5.0 points) was registered in the Boguslav, Gleb, and Seym 20 varieties. The standard Izhevskaya 2 had the highest density of productive stems (162–395 stems/m²), and the Gleb variety had the largest grain size (47.4–48.1 g). During the years varying greatly in weather conditions, the Gleb variety produced the highest grain yield of 270–654 g/m², with a density of productive stems of 233–327 stems/m² and a spike productivity of 1.16–2.05 g. The Izhevskaya 2 standard was notable for its high crude protein content (14.1 %) in the grain, while the Boguslav and Alatyrskaya 75 stood out for their high fat content (1.61–1.73 %). The grain of the Pakhar variety had a low content of fiber (1.93 %) and ash (1.26 %).

Key words: winter triticale, variety, winter hardiness, snow mold, brown rust, lodging, yield, yield structure, grain quality.

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PRODUCTIVITY AND FODDER VALUE OF GRASS MIXTURES WITH REED FESCUE DEPENDING ON NITROGEN NUTRITION LEVEL

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Abstract. The relevance of the study lies in the necessity of creating an efficient nitrogen fertilizer system for legume-cereal grass mixtures during multiple cuttings. This system should enhance productivity, protect the sown grass species, and ensure the nutritional feed value of the harvested plant material. The aim of the study was to investigate the effect of nitrogen nutrition level on the productivity of legume-cereal grass mixture with reed fescue during three cuttings per season. The research was conducted during the field experiment in the Vologda region. The soil of the experimental plot was drained, sod-podzolic, medium-cultivated, and medium-loamy. The control variant (1) was fertilized with enriched superphosphate and potassium chloride since the spring, variants 2-7 – with diammonium phosphate. In the 1st year, the ammonium nitrate fertilization was applied for the variants 2 and 5 after the first mowing, and only variant 5 was fed with it after the second mowing. During the 2nd year, variants 2 and 3 were fertilized once, and variants 5 and 6 – twice. The other variants were not fed. The research results found that the use of mineral nitrogen in the 1st year of the study did not have a significant effect on the productivity (8.9-9.9 t/ha of dry matter) of the grass mixture, but it had an impact on its species composition and the height of the cereal grasses. In the second year, the application of nitrogen fertilizers had a significant effect on the yield of the grass mixture in variants 2, 5, and 6. The increase compared to the control was 0.7-1.0 t/ha of dry matter, or by 9.6-13.7 %. The protein content increased to 17.7-19.0 % per 1 kg of dry matter. When nitrogen was used, the proportion of cereal grasses increased in the first mowing (variants 2-7) to 29.6-33.9 %, in the second mowing (variants 2, 3, 5 and 6) to 26.5-39.3 %, and in the third mowing (variants 5 and 6) to 23.1-28.8 % respectively. The results have revealed that mineral nitrogen is more effective when applied to legume-cereal grass mixtures from the second year of use.

Key words: perennial grasses, fertilizer doses, mineral nitrogen, top dressing, three mowings, species composition.

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COMPARATIVE ANALYSIS OF PRODUCTIVITY OF SPRING OAT VARIETIES DEPENDING ON MINERAL NUTRITION

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Abstract. The article presents a comparative analysis of the productivity of a variety and a variety line of oats at different levels of mineral nutrition. The study included an analysis of the main indicators of crop structure and biological yield. The purpose of the research was to develop and improve technological methods for cultivating oats of the Yakov variety and the 91h18 variety line, providing high yields and grain quality in the south-eastern part of the forest–steppe zone of the Non–Chernozem Region. The research was conducted in the Mordovia Research Institute of Agriculture, a branch of the Institution of the FARC of the North–East, in the south of forest–steppe zone of the Non–Chernozem Region in 2023–2024. The experiment compared the standard Yakov variety and the 91h18 variety line at different levels of mineral nutrition: 1) the control variant (without fertilizers); 2) the application of the nitrogen-phosphorus-potassium fertilizer (background) – 2 c/ha; 3) background + top dressing N60 (ammonium nitrate). The seeding rate was 5 million germinating seeds per hectare. The nitrogen-phosphorus-potassium fertilizer was introduced during the pre-sowing tillage, and the ammonium nitrate was added at the beginning of oat tillering. According to the research results, it was found that mineral fertilizers had a positive effect on the productivity indicators of the new 91h18 variety line, in comparison with the standard Yakov variety, the positive indicators of crop structure components and biological productivity were obtained when N60 was added at the tillering phase followed by the application of nitrogen-phosphorus-potassium fertilizer. Under these conditions, the 91h18 variety line exceeded the Yakov variety by 90 % (38 pcs.) in the number of grains per panicle, by 9.3–9.6 % (39.8–39.9 g) in the weight of 1 000 grains, and by 161 % (7.70 t/ha) in the biological yield. The standard with the application of background + N60 had lower values of the above indicators.

Key words: oats, variety, nitrogen-phosphorus-potassium fertilizer, top dressing, plant height, panicle length, productive stems, number of grains, weight of 1000 grains, biological yield.

For citation: Ryabkin E. A., Eryashev A. P. Comparative analysis of productivity of spring oat varieties depending on mineral nutrition. The Bulletin of Izhevsk State Agricultural Academy. 2026; 1 (85): 21-31. (In Russ.). https://doi.org/10.48012/1817-5457_2026_1_21-31.

FORMATION OF SOYBEAN YIELD IN THE MIDDLE URALS AND ADAPTIVE PROPERTIES OF VARIETIES FROM DIFFERENT ECOLOGICAL AND GEOGRAPHICAL ORIGIN

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Abstract. The key factor in the management of soybean farming in the region is the selection of the right variety with a short growing season, capable of maturing during the brief and cool summer. The purpose of the research is to evaluate the adaptive potential of soybean varieties for feed grain under the agroecological conditions of the Middle Cis-Urals. The studies were conducted to examine the adaptive properties of soybean varieties Georgiya, Lumaria, Pamyati Fadeeva, Civil and Yuzhanka. A correlation analysis of yield formation depending on the agrochemical properties of sod-podzolic soil allowed us to establish a weak relationship with the humus content, an average relationship with the content of mobile potassium and a strong relationship with the content of mobile phosphorus. The meteorological conditions of the growing season over the years of research were different, both in terms of temperature conditions and humidity. The highest yield of 1.25-2.36 t/ha of soybean varieties was obtained in a relatively favorable year in 2024, with sufficient moisture during the branching-flowering stage and a dry and hot period during grain maturation. Soybean yields were proved to be significantly influenced by environmental conditions, accounting for 43.3 %. The share of the genetic characteristics of the variety and the interaction of variety × conditions accounted for 25.1-29.7 %. The research results for the period 2022-2025 revealed that soybeans could be grown on low-fertile sod-podzolic soil to produce fodder grain, providing the necessary nutrition for plants, as indicated by the strong and moderate correlation between grain yield and mobile phosphorus and potassium content. The plasticity coefficient $b_i = 0.1-0.8$ for the Pamyati Fadeeva and Yuzhanka varieties indicates their high adaptability to yield formation under various abiotic conditions.

Key words: variety, plasticity, stability, stress resistance, genetic flexibility, agrochemical characteristics of the soil.

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Original article

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PEACH INTRODUCTION IN THE MIDDLE CIS-URALS WITH FRUIT QUALITY ASSESSMENT

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Abstract. Positive results on the peach introduction have been first obtained in the Middle Cis-Urals. Adaptive forms of plants with sustainable growth, development and fruiting were obtained. The time of peach frondescence beginning occurred in the Middle Cis-Urals on April 28-30, the beginning of flowering, depending on weather conditions, took place on May 8-12, the beginning of leaf fall occurred after night frosts down to $-2\text{ }^{\circ}\text{C}$, no significant differences among the peach hybrids were observed. The period from the beginning of flowering to fruit ripening was 75-84 days. The average weight of a peach fruit varied from 26.3 g to 80.5 g depending on the research year, the maximum weight of one fruit reached 137 g. The fruits of peach hybrids had high biochemical indicators: dry matter content - 15.5-21.75 %, soluble solids - 11.65-20.50 %, vitamin C - 21.55-31.70 mg/100 g. The tasting assessment of the fruit, depending on the year of research and the hybrid form, ranged from 3.8 points to 5.0 points. The results of the peach introduction and the fruit quality assessment allow us to consider it to be a promising crop for further cultivation in amateur gardens in the Middle Cis-Urals, enhancing the diversity of stone fruit crops in the region.

Key words: peach, introduction, fruiting, fruit quality.

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Original article

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METHODOLOGY FOR THE STUDY OF PUBLIC PERCEPTION OF GREEN AREAS: INTEGRATION OF QUANTITATIVE AND QUALITATIVE DATA FOR SUSTAINABLE MANAGEMENT OF URBAN ECOSYSTEMS

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Abstract. The article is devoted to a comprehensive study of the subjective perception of green areas by the population of Ufa. The urgency of the research is dictated by the insufficient knowledge of this aspect in comparison with the objective parameters of the green areas. The purpose of the study is to analyze public opinion in order to develop scientifically based recommendations for optimizing the management of urban ecosystems, taking into account the recreational and psychophysiological needs of residents. The scientific novelty consists in conducting a large-scale survey (n=1000), integrating an assessment of recreational preferences, psychophysiological effects and aesthetic perception of tree species, which was carried out for the first time in Ufa. A strong correlation ($r=0.87$) has been established between the proximity of the place of residence and the frequency of visits to green areas. Culturally determined patterns have been identified: 73 % of respondents recognize the healing properties of trees, with a ranking of species by "energy" importance (pine – 23 %, birch – 21 %). The high importance of aesthetic parameters has been found – 67 % of respondents prefer trees with a spreading crown. The practical significance of the work lies in the development of a methodology for integrating public perception data into urban ecosystem management, which makes it possible to move from a unified approach in landscaping to personalized solutions that take into account regional peculiarities and cultural preferences. The results can be used for planning recreational infrastructure and developing an assortment of tree species.

Key words: green areas, perception, recreational preferences, psychophysiological impact, tree species, urban ecosystems, management.

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Original article

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IMPROVEMENT OF BLASTING TECHNOLOGIES FOR CREATING MINERALIZED FIRE LINES

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Abstract. The article considers the urgent issues of forest fire control and substantiates the need for the development of modern technologies for laying the fire barrier lines in remote and hard-to-reach areas, including the use of explosive materials. The research analyzed literary and departmental sources on using different explosives for preventive measures, fire

protection, and extinguishing forest fires. The practical experience of extinguishing fires by laying the support and control mineralized lines with the use of explosives was also analyzed. The study highlights the benefits of using explosive materials over manual methods, fire-resistant screens, and foam agents for creating firebreaks. It also emphasizes the need to advance explosive technology to prevent forest fires. It has been established that the use of high-power detonating cords significantly increases the efficiency of their use in comparison with other methods of laying support lines in remote areas. The technical characteristics of high-power detonating cords, comparative test results, and recommendations for their use are presented. The DSHN-M-160 high-power detonation cord model has been proven effective in creating a mineralized line extending to the humus mineral soil layer, using just one detonating cord line in the given forest conditions. The average width of the mineralized line was 35 cm, the total soil spread averaged 340 cm, the depth of the line was about 13 cm, and the height of the deposit from the explosion was 230 cm. When carrying out explosions under the canopy of the forest, there is a slight flash (compared to the DSHN-80), however, the use of a spray device with an explosive network lock at the site of the detonator capsule prevents ignition of the forest floor even at high temperatures, low relative humidity and close to dry forest combustible materials.

Key words: forest fires, explosive materials, laying the mineralized fire lines, remote territories, detonating cords.

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Original article

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ANALYSIS OF PINE AND OAK CULTIVATION TECHNOLOGY ON ASPEN CLEARINGS IN ZHIVOTINOVSKOYE FORESTRY DEPARTMENT OF THE EDUCATIONAL AND EXPERIMENTAL FORESTRY OF VSUFT

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Abstract. The long-term 40-year study assessed the effectiveness of a technology for establishing mixed pine and oak stands on challenging aspen clearings within fresh oak forests (Zhivotinovskoye Forestry, Morozov VSUFT). This research is crucial as it addresses the urgent need for efficient reforestation methods in clearing areas densely overgrown with root-

suckering aspen, reaching up to 180,000 trees per hectare. Traditional techniques are both time-consuming and ineffective in such conditions. The research purpose was to analyze the long-term productivity and sustainability of crops established using a mechanized technology. Materials and methods included a retrospective analysis of plantation crops established in 1979-1982 using an MUP-4 machine for stump cutting and double disking (BDK-2.5) to suppress aspen growth. The planting was carried out according to the pine-oak pattern with a spacing of 2.5×0.5 m. The results revealed a dual effect. In the early years, the technology ensured high survival rates (95 % for pines, 91 % for red oaks after 4 years) and effective aspen suppression. However, by the age of 40, there was a critical failure regarding oak trees: pedunculate oak was almost completely eliminated, red oak perished, their preservation rates dropping to 5-30 %. Conversely, pine achieved outstanding productivity: site class I-Ia, timber stock of 48 m³/ha, average diameter of 27 cm. The primary reason was oak's inability to compete for light with the fast-growing pine, which closed the canopy by 10-15 years. Active invasion by Norway maple was noted. The applied technology proved highly effective for establishing productive pine monocultures on challenging clear-cuts but was unsuitable for the long-term restoration of oak forests. The obtained data should be used to develop new patterns for mixing species and silvicultural techniques that account for light competition and edaphic conditions, as well as for planning targeted pine plantations.

Key words: oak forest crops, aspen clearings, reforestation, technology.

For citation: Kaloshin V. P., Samoshin S. E. Analysis of pine and oak cultivation technology on aspen clearings in Zhivotinovskoye Forestry Department of the Educational and Experimental Forestry of VSUFT. The Bulletin of Izhevsk State Agricultural Academy. 2026; 1 (85): 62-69. (In Russ.). https://doi.org/10.48012/1817-5457_2026_1_62-69.

Original article

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BIOLOGICAL RECLAMATION OF OIL-DEPLETED AREAS IN THE UDMURT REPUBLIC

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Abstract. The mechanical disturbance of forest fund lands by mining enterprises is aggravated by their pollution resulting from emergency situations. Most projects at the initial biological stage, unlike the forestry approach to reclamation, focus on sowing perennial grasses rather than establishing forest crops on forested lands. This is often due to the developers' limited expertise in restoring forest vegetation on disturbed sites. The purpose of the study was to explore the features of forest vegetation recovery and the necessity for active measures to

expedite this process within the oil-producing region of the Udmurt Republic. The research objectives were as follows: to investigate the processes of natural and artificial restoration of vegetation cover; to identify patterns of formation of plant communities; to develop recommendations for improving the recovery efficiency and acceleration in areas disturbed by oil production. The study began with an inventory of land plots and a summary of forestry data on planting forest crops on reclaimed lands and clearings. The information obtained was used as the initial data for the selection of field observation objects in accordance with the set program issues. The detailed route reconnaissance was carried out for the survey of the areas. The research was based on the method of sample areas with registration plots. The overgrowth of production induced sites is slow in the areas of the surveyed deposits. The grass cover is regenerated with the species of the original communities, with the addition of synanthropic ones. Restoration of disturbed forest ecosystems occurs according to the zonal type. The low resistance of coniferous species to anthropogenic disturbance is noted. Spruce and pine appear 10-11 years after the pollution and 6-7 years after the mechanical disturbance, deciduous trees colonize technogenic zones within the first 1-2 years. Violations of technological requirements in the creation of crops were identified. The exclusion of the technical stage in forest reclamation sites reduces the conservation of forest plantations to 26-68 %.

Key words: biological reclamation, biological stage, technical stage, polluted soil, oil-polluted lands, recultivated lands, conservation, forest crops, living ground cover, covering land with a fertile soil layer, phytocenoses.

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Original article

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PROTEIN CONTENT AND CHEESE-MAKING SUITABILITY OF MILK FROM BLACK-AND-WHITE COWS

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Abstract. The Russian cheese market, one of the world's largest, is expanding. In the context of import substitution and sanctions pressure, the issue of providing the industry with high-quality domestic raw materials is urgent. The aim of the study is to evaluate the suitability of milk of Black-and-White cows for cheese production under intensive milk production technology. The objectives are: to evaluate the protein and casein levels in cows' milk over the

course of a year; to evaluate the suitability of milk for cheese production based on the casein quality and the rennet test quality; to conduct a control production of cheese and to evaluate its organoleptic and physiochemical properties. The studies were conducted at the Izhagroplem Scientific and Production Complex and at the Department of Technology of Production and Processing of Livestock Products of the Udmurt State Agricultural University. The study focused on the Black-and-White cows of the production group. On average for the study period, the protein level in milk was 3.25 % (fluctuations 3.01–3.29 %), incl. casein 2.70 % (fluctuations 2.66–2.72 %), the correlation coefficient was 0.66. The highest calcium content in milk was observed in spring (126.1 mg%), the minimum – in autumn (121.4 mg%), the difference was 4.7 mg% ($P \geq 0.999$). Structural parameters of casein micelles were relatively constant (diameter 673.3–679.7 Å, weight 130.5–132.6 million units). The duration of milk coagulation with rennet increased from winter to autumn (from 28.5 to 35.3 min). The coagulation phase was the most stable – 25.1-27.15 min. The gelling period was minimal in winter (3.45 min) and maximal in spring (8.35 min). Overall, the milk was suitable for cheese production. Cheese produced from the milk of farm's cows scored 90–93 points in the tasting assessment, placing it in the highest grade. The cheese yield was also above average, reaching 14-15 %.

Key words: Black-and-White breed, protein quality, casein, cheese-making suitability, rennet coagulation, cheese quality.

For citation: Berezkina G. Yu., Fomina A. A., Khardina E. V., Shkarupa K. E. Protein content and cheese-making suitability of milk from Black-and-White cows. *The Bulletin of Izhevsk State Agricultural Academy*. 2026; 1 (85): 78-84. (In Russ.). https://doi.org/10.48012/1817-5457_2026_1_78-84.

Original article

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THE STATE OF CAMEL BREEDING IN OOO SONN IN THE YASHKULSKY DISTRICT OF THE KALMYK REPUBLIC

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Abstract. The purpose of the research was to assess the state of the camel husbandry in the OOO Sonn breeding plant in the Yashkulsky district of the Republic of Kalmykia. The number of Kalmyk camels of the farm, their breed and class composition were studied during the extended research. When studying the livestock, generally accepted methods were used, the body conformation of animals was carried out according to the current instructions for the classification of double-humped camels. The study reveals that the average measurements and

live weight of the Kalmyk camels on the farm's breeding stock closely match those of the general population from leading farms in the Republic of Kalmykia and the Astrakhan region, which may indicate successful breeding efforts in the farm. All leader camel producers in the flocks have been awarded the Elite grade. In the breeding stock, 63.7 % were Elite class animals, while 36.3 % were First class. These parameters indicate that the population of Kalmyk camels of the farm meets the requirements for breeding animals. The total number of Kalmyk camels in the period under review (2019-2023) decreased by 7.1 %. During the same period, the proportion of female camels in the total population increased up to 85.8 %, and this fact could be considered as a solid base for revitalizing camel breeding in the republic. According to the main indicators, the productivity of Kalmyk camels on the breeding farm corresponds to the level of productivity of camel farms in the Republic of Kalmykia and the Astrakhan region. The number of colts has declined slightly due to harsh weather conditions in recent years. The total colts crop showed the greatest year-to-year fluctuation ($Cv = 23.28$ %). This suggests that the herd's reproductive performance was instable over the study period. The indicators of the average wool output, milk production per camel, and the average live weight of young Kalmyk camels remain within satisfactory limits.

Key words: pasture livestock farming, camel breeding, Kalmyk Bactrian camels, grading, class composition, measurements, color.

For citation: Bolaev V. K. The state of camel breeding in OOO Sonn in the Yashkulsky district of the Kalmyk Republic. The Bulletin of Izhevsk State Agricultural Academy. 2026; 1 (85): 85-92. (In Russ.). https://doi.org/10.48012/1817-5457_2026_1_85-92.

Original article

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FEATURES OF THE GENETIC STRUCTURE OF LITHUANIAN HEAVY DRAFT HORSES BY MICROSATELLITE LOCI

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Abstract. Microsatellites are the most popular markers in studies of the genetic characteristics of horses. They provide an opportunity to study the features of the gene pool, to obtain data on the formation and evolution of breeds. The purpose of this study was to evaluate the genetic structure of the Lithuanian heavy draft breed of horses based on microsatellite DNA loci of the Russian population and the horse population in Lithuania, and to determine the genetic diversity in various populations using microsatellite markers. The research was conducted on the basis of the Semenovskiy breeding plant in the Republic of Mari El. The study was focused on purebred horses of the Lithuanian heavy draft breed with confirmed origin, the materials

were DNA certificates with the results of genotyping of horse hair samples at 15 microsatellite loci. The data on the number of horses in the Republic of Lithuania were taken from the studies of R. Juras, E. G. Cothran. The research results have revealed that the genetic structure of the Russian population of the Lithuanian heavy draft breed is more diverse than that of Lithuanian-bred horses, though only one farm is engaged in breeding horses of this breed in Russia. The study of the genetic structure of the Lithuanian heavy draft breeds of Russia and Lithuania provides the opportunity of breeding work with the breed without reducing genetic diversity and the consequences of inbred depression. The coefficient of inbreeding (F_{is}) in both the domestic and Lithuanian populations is negative and amounts to 0.007 and 0.016, respectively, indicating an excess of heterozygotes. This suggests a low degree of inbreeding and unrelated mating. The investigation of the genetic structure of Lithuanian heavy draft horses of the Russian and Lithuanian populations is of great interest for researchers, since these two subpopulations evolve independently, with no exchange of breeding stock.

Key words: Lithuanian heavy draft breed of horses, microsatellites, heterozygosity, genetic diversity.

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Original article

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EFFECT OF PREPARTUM EXERCISE ON CALVINIG AND REPRODUCTIVE FUNCTION RECOVERY IN COWS

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Abstract. The intensification of milk production in Donbass is impossible without optimizing the conditions for keeping cows standing dry before calving, as well as properly ensuring the technological features of the parturition process and postpartum care of new-calved cows. This includes daily dynamic walks for down-calving cows, which allow for better preparation of the animals for calving and postpartum increasing the milking capacity, ensuring the preservation of the reproductive system and extending their lifespan. This study is crucial due to the pressing need to reduce the premature culling of cows caused by reproductive disorders in intensified dairy breeding. The experiment was conducted on the Krot Farm (LPR) on two groups of dry cows ($n = 10$), formed by using the method of analog groups. The cows in the experimental group (I) had daily forced active exercises (walking 2.5 km at a calm pace) for 2-3 days before calving. The control group (II) was prevented from active exercises 14-15

days before calving, which corresponded to the standard farm technology. Dynamic activity of dry cows has been shown to shorten all stages of the birthing process by 14 %, decrease instances of retained placenta, ensure timely discharge of lochia, and reduce diseases affecting the birth canal, the uterus, and the mammary gland. In addition, the service period of the experimental cows is reduced by 2.1 times, and the dry period is reduced by 1.6 times. Prepartum active exercise is a highly effective technological method which provides the opportunity of preventing the complications during calving and postpartum diseases, as well as significantly reducing the length of both service and dry periods.

Key words: down-calving cows, exercise, calving, preventing the complications during calving, preventing postpartum diseases.

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EFFECT OF THE BIOPREPARATION ANTIKLOS IN FEEDING RATIONS ON MILK PRODUCTIVITY AND REPRODUCTIVE PERFORMANCE OF COWS

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Abstract. Dairy cattle are the most demanding in terms of optimal feeding and housing conditions. Therefore, special attention should be paid to the control and prevention of diseases. The aim of the scientific research was to study the effect of the biological product AntiKlos on the milk yield and reproductive capacity of first-lactation cows. Two groups of 45 first-lactation Black-and-White cows were selected and formed for the study, they were kept on the D. I. Ponomarev Farm in the Zavyalovsky District of the Udmurt Republic. The control group of animals had the standard ration used in the farm, while the experimental group was given the AntiKlos feed additive as supplement to the standard ration once a day during the morning feeding. It was added with concentrate feeds at a rate of 50 g/head per day, starting from the 1st day after calving. The experiment lasted for 305 days. Milk yield of the cows was assessed during control milkings over two consecutive days, and milk quality was determined using generally accepted methods. Reproductive functions of primiparous cows were evaluated based on the length of the service period, the intercalving period, the conception rate, and a reproductive efficiency index. The research results showed that the use of the biological product AntiKlos in the diet of first-lactation cows had a maximally positive impact on increasing the milk yield of the experimental animals over 305 days of lactation, which

amounted to 6278.00 kg, a statistically significant ($P \geq 0.95$) increase of 413.75 kg compared to the control group. The amount of milk protein and fat in the experimental group was 192.73 kg and 246.1 kg, respectively, which was higher by 7.6 % and 8.2 % than in the control group. The physicochemical milk composition in cows of the experimental group was superior in terms of lactose, ash, SNF (Solids-Not-Fat), and dry matter content. The use of the biological product contributed to the improvement of the reproductive qualities of cows.

Key words: Black-and-White breed, cows, AntiKlos biopreparation, milk productivity, reproductive qualities.

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Original article

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EFFECT OF PROBIOTIC AND PHYTOGENIC FEED ADDITIVES ON THE PHYSIOLOGICAL STATE OF CALVES

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Abstract. Maintaining the health and increasing the metabolism and productive qualities of young cattle by using active probiotic and phytogetic components in their diets is relevant and of scientific and practical interest. The aim of the research was to study the effect of the Enzymsporin probiotic product and a coniferous feed additive on the livability and physiological state of calves. Calves aged up to ten days were selected for the study and divided into three groups according to the pair-analogue method (one control and two experimental groups), with 15 calves in each group. The conditions of keeping and feeding the animals were identical. The obtained analytical data provide evidence that most of the calves in the experimental groups had similar indicators of metabolic processes in their bodies, and in a close range, that is, their protein, carbohydrate, and lipid metabolism was within the physiological range, indicating a positive effect of the probiotic and phyto supplement on the animals' metabolic activity. Calves given both the probiotic Enzymsporin and a phytogetic feed additive had a significant increase in total protein content by 1.5% ($p \leq 0.05$), their urea levels dropped by 11.5% ($p \leq 0.05$), and albumin levels trended upward by 0.54 g/L, or 1.3%, compared to the control group, suggesting the intensification of protein metabolism. The calcium levels and calcium-to-phosphorus ratios in the experimental groups were more advantageous compared to the control group. The studies have revealed that incorporating the

active ingredients of the Enzimsporin probiotic product and a coniferous feed additive enhances the health and metabolic function of calves during their rearing.

Key words: probiotic, phytobiotic, calves, livability, physiological state, blood biochemistry.

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Original article

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EFFECT OF A NEW FEED ADDITIVE IN THE DIET OF LAYING HENS ON THE EGG PRODUCTION

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Abstract. Broiler producers are particularly interested in mineral complexes appreciating them among all feed additives. These additives aim to lower mortality rates and enhance the quality of the products. The article presents the results of a study on the effect of the new feed additive Citrimin on the egg production of laying hens, as well as the mineral and chemical composition of eggs. The experiment was conducted in the industrial production facilities of Chebarkulskaya Ptitsa focusing on Loman Brown hens that were 30 weeks old and it lasted for 30 days. Two groups, each consisting of 100 birds, were formed. The control group consumed the basic diet, while the experimental group was given Citrimin at a dose of 60 g/t of feed, in addition to their regular diet. The conditions were identical for all birds. The study found that the addition of Citrimin to the hens' diet increased the number of eggs produced and improved their quality, particularly their weight. The average egg weight in the experimental group exceeded the control by 4.4 %, resulting in an increase in the total yield of egg mass: 165.7 kg in the experimental group compared to 154.99 kg in the control group, an increase was of 6.9 %.

Key words: feed additive, zinc, productivity, laying hens, eggs.

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RESEARCH ON THE POSSIBILITIES OF USING ALBUMIN COTTAGE CHEESE IN SPECIALIZED DAIRY PRODUCTS

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Abstract. Studying the efficient ways for milk whey application remains a crucial challenge. It should be noted that whey products offer high nutritional value at a low cost. This research focuses on the development of a specialized dairy product based on albumin cottage cheese. Albumin curd is produced from cheese whey, it contains complete, easily digestible proteins, but it has a flat taste and flavor and a limited shelf life. Due to its beneficial properties, milk albumin has long been a popular choice in athletes' nutrition, so we selected athletes and individuals with active lifestyle as the target audience for the new product. The product development involved several stages: marketing research, the formulation and production technology development, a sample development and evaluation, and the feasibility study. Based on a survey of athletes, it was decided to create a dairy albumin product in a snack form, a glazed curd bar. Three recipes were developed with different plant-based fillers: poppy seeds, oat flakes, and coconut flakes. The technology involved treating the curd with lactase, which increased the product sweetness, and using citric acid as an acidity regulator to extend its shelf life. All samples received high scores in the organoleptic evaluation—at least 19 out of a possible 20. While producing albumin curd bars is highly profitable, the limited shelf life of the product remains a challenge, so finding sustainable markets is essential for its distribution. The developed product has a high content of biologically valuable protein (13.0–13.5 %), low lactose content, no sucrose, low fat content, and contains plant-based dietary fiber. It can be recommended not only for sport nutrition but also as a functional product for all population groups from the age of three.

Keywords: cottage cheese, milk whey, dairy products, protein, albuminous cottage cheese, product.

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THE PROBLEM OF POSTPARTUM HYPOCALCEMIA IN HIGH-YIELDING COWS IN A DAIRY CATTLE COMPLEX

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Abstract. Clinical hypocalcemia is the most common disease in dairy cattle. The greatest economic loss is caused by the subclinical form, which leads to metabolic disorders and the development of metritis, ketosis, displacement of rennet, and retention of the placenta in cows. The aim of the study was to analyze the number of cases of clinical and subclinical hypocalcemia in cows and heifers in dairy production. The study was conducted in a dairy farm on 54 animals for 6 months (18 cows, 18 first-calf heifers, and 18 cows during the dry season). The average daily milk yield per dairy cow per day is 36.5 liters, with a fat content of 3.8 %. It was found that the level of calcium in the blood of cows began to decrease from the first day of lactation, it began to rise by the third day, apparently due to the body reserves and metabolism activation, and amounted to 2.0-2.2 mmol/l. However, these values were 0.5-0.3 mmol/l lower than reference values, which may lead to the subsequent development of subclinical hypocalcemia. Of the 18 animals studied, 67 % had subclinical hypocalcemia, 22 % had clinical hypocalcemia, and 11 % had blood calcium levels within normal range. The first-calf cows had the same blood calcium level during the first three days of lactation, averaging 2 mmol/L, and increased to 2.1 mmol/L only by the third day. The level of calcium in the blood of the first-calf cows did not fall to critical values and was within the minimum norm. 89 % of cows had the indicators of an approximate blood calcium content to subclinical hypocalcemia, and only 11% of animals had this indicator within the normal range. There were no cases of clinical hypocalcemia among the first-calf cows. Both the cows and the first-calf cows are susceptible to subclinical hypocalcemia in the first three days of lactation, and it accounted for 85 % of their total number. Blood calcium levels, measured immediately after milking and four hours after feeding, revealed almost no dietary calcium recovery. The average increase over the entire study period was only 0.1-0.2 mmol/L. First-calf heifers use less calcium per smaller volumes of colostrum and milk, and their metabolic rate is higher, so hypocalcemia is less common and is quickly compensated by their body's reserves.

Key words: cows, calving, lactation, milk, hypocalcemia.

For citation: Khotmirova O. V. The problem of postpartum hypocalcemia in high-yielding cows in a dairy cattle complex. The Bulletin of Izhevsk State Agricultural Academy. 2026; 1 (85): 134-139. (In Russ.). https://doi.org/10.48012/1817-5457_2026_1_134-139.

EFFECT OF THE FEED ADDITIVE NCG-N-CARBOMYLGLUTAMATE ON THE VITAMIN CONTENT IN BLOOD OF FATTENING BULLS

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Abstract. The body requires vitamins because they are essential for biochemical reactions, crucial for the proper functioning of all organs and systems. The aim of the study was to investigate the effect of the feed additive NCG-N-carbonylglutamate on the vitamin composition of the blood of Simmental bulls. The scientific experiment was conducted at the I. V. Tsybankov Farm, in the Navlinsky District of Bryansk Region. The study was focused on the 6-month-old fattening bulls. Veterinary care and preventative measures were provided for the experimental animals. At six months, two groups of Simmental bulls were formed using the pair-analog method. The experimental group was individually given the feed additive in a grain mixture at a rate of 5 grams per head per day. The duration of the experiment was 90 days. The blood vitamin profile was determined using an Azura (Knauer) automatic amino acid and vitamins analyzer. Changes in the blood vitamin content of fattened bulls were observed during the period of the usage of the feed additive. The concentration of fat-soluble vitamins tended to increase from 0.5 % to 3.28 %. Water-soluble vitamins showed a significant increase: group B vitamins from 5-10.0 %, vitamin H – 5-8.33 %, and H1 6.58-10.69 %, respectively. The application of the feed additive NCG-N-carbonylglutamate contributed to an increase in the enzymatic and microbiological processes of rumen digestion, the formation of intermediate metabolites, and their utilization by the body of growing bulls.

Key words: bulls, feed additive, blood, fat-soluble vitamins, water-soluble vitamins, live weight.

For citation: Tsygankov E. M., Menkova A. A., Kozlov S. A., Chernenok V. V., Bobkova G. N. Effect of the feed additive NCG-N-carbonylglutamate on the vitamin content in blood of fattening bulls. The Bulletin of Izhevsk State Agricultural Academy. 2026; 1 (85): 140-148. (In Russ.). https://doi.org/10.48012/1817-5457_2026_1_140-148.

ANALYSIS OF THE PRINCIPLE OF MOISTURE MEASUREMENT BY THE CAPACITANCE METHOD

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Abstract. Soil moisture is the main critical factor determining the growth and development of plants and their microbiological activity. Soil moisture measurement is a crucial indicator that helps evaluate the condition of the ground, its water balance, and affects the efficiency of irrigation and plant growth. The study is relevant because the accuracy of soil moisture measurement is necessary for monitoring droughts and conducting scientific research in the soil science. The purpose of this study is to identify the main patterns and ways to achieve high accuracy in measuring soil moisture, as well as to establish the basic principles of soil moisture measurement. There is a wide range of methods and sensors available for measuring soil moisture, which are based on various physical principles. The article provides an analysis of the principle of moisture measurement by the capacitance method. The physical basic principles of the interaction of electromagnetic waves with wet material, which determines the change in the dielectric constant and, as a result, the capacitance of the measuring cell, were considered. The factors affecting the accuracy of measurements, such as temperature, density, and composition of the measured substance, were analyzed. To achieve the desired level of accuracy in measuring soil moisture as a physical quantity, it is necessary: to select an appropriate measurement method based on measuring the dielectric constant, to select an appropriate primary transducer, and to develop and implement a measurement circuit using a secondary transducer. Special attention is paid to the analysis of the capacitance method of moisture measurement, as one of the most widespread and promising. The proposed methodology allows evaluating the key characteristics of soil moisture sensors, including accuracy, stability, and reproducibility of the results. Additionally, the methodology provides an opportunity for a comparative analysis of various methods of moisture measurement, which promotes the optimal solution for specific tasks and conditions. The research results made it possible to model an improved soil moisture measurement system with the justification of the primary and secondary transducers.

Key words: capacitance sensor, moisture measurement, electrical signal, primary and secondary transducer, linearity, calibration.

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Original article

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DESIGN OF ACTIVE VENTILATION IN A PHYTOTRON CHAMBER

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Abstract. A phytotron is a unit designed to conduct experiments on growing plants under strictly controlled conditions. In the case of developing a household phytotron, the primary factor for controlling the microclimate through ventilation is the air temperature within the chamber. When designing a phytotron with unique design solutions, it is necessary to conduct an individual technical analysis of ventilation. This research aims to obtain a design solution for the ventilation system for the phytotron under development. To achieve this goal, the following tasks were set and completed: developing a ventilation design methodology and designing a ventilation system for the device being developed. An analysis of the concept of dividing the phytotron into two chambers was conducted: a plant growing chamber and a soil heating chamber. Simplified air flows passing through the phytotron chambers were described and analyzed. The S01138812H fan was selected as the ventilation equipment. An electrical circuit for an active ventilation system based on a computer fan was developed. The operating parameters of the fan were calculated based on agronomic recommendations for ventilation design. The calculated operating mode relative to the nominal mode allows for a softer regulation of the temperature level in the phytotron chamber. A generalized block diagram of the automatic ventilation system was considered and the necessary technical equipment for its implementation was described. A logical block diagram of the subroutine for automatic control of the ventilation fan for maintaining the temperature mode in the phytotron chamber was presented. A logical block diagram of the subroutine for implementing the P-law of temperature control with a binary fan control signal has also been developed. This system efficiently regulates the fan performance, which in the nominal mode significantly exceeds the recommended one.

Key words: phytotron, active ventilation, fan, automated system, temperature control, protected ground.

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EXPERIMENTAL SUBSTANTIATION OF THEORETICAL MODELS OF THE PHYTOTRON HEATING SYSTEM OPERATION

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Abstract. The efficiency of a phytotron heating system directly impacts microclimate parameters, plant physiological conditions, and the reproducibility of experimental results. Therefore, experimental validation of the developed theoretical models is essential. This validation confirms the correctness of the descriptions of thermal processes and the validity of their application in the design, adjustment, and modernization of phytotrons. The aim of the study was to confirm the ability of the developed theoretical models to correctly describe thermal processes in the phytotron chamber. The study was conducted using the developed multi-purpose compact phytotron. A mathematical model of air heating dynamics, a temperature field distribution model, and a computer model for maintaining a given air and substrate temperature, implemented in the Comsol Multiphysics software package, were tested. The theoretical models are based on a description of natural convection of heated air, determined by the Bernoulli equation, and a method for separating variables to solve the differential equation for airflow energy. The experimental testing included two modes: high-temperature (37 °C for air and 42 °C for soil) and low-temperature (22 °C for air and 27 °C for soil). The validity of the models was assessed by comparing experimental and simulated data. The initial versions of the models showed significant deviations from the experimental data due to inconsistencies between the input parameters of the actual design and the experimental conditions. After adjusting the model parameters, the maximum deviations in air and soil temperatures did not exceed ± 1 °C, and the temperature field unevenness indicators were within the permissible error limits. The temperature distribution shapes obtained as a result of the simulation and experiment showed qualitative agreement. The theoretical models of the phytotron heating system operation were experimentally validated. It has been established that with correct input parameters the developed models adequately describe the heating dynamics and temperature distribution and can be used for further calculations and design solutions without additional adjustments.

Keywords: phytotron, temperature control, heating system, mathematical modeling, computer modeling, protected ground.

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RESEARCH ON THE EFFECT OF OVERVOLTAGE IN THE TRANSFORMER-AIR OZONIZER SYSTEM ON ITS SAFETY

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Abstract. The results of modeling transient electrical modes and their constituent processes occurring in the transformer–air ozonizer system are presented. The article explores how overvoltage affects the safety of a transformer–air ozonizer system. The ozone generator equivalent circuits (of corona and barrier discharge types) are provided. The obtained results of simulations of transient electrical modes provide the opportunity to determine the safety of the transformer–air ozonizer system, avoiding overvoltage in the transformer–air ozonizer system (during the system switching, during the programmed automatic on and off cycles). Such overvoltage could cause transformer failure, either through winding damage or dielectric breakdown on the barrier ozonizer plates, preventing the necessary ozone concentration in the rooms. The system operational modes, the processes of ozone and ion formation within the discharge gap, and stable performance of the system under production conditions were determined. It has been shown that the experimental and simulated values of current and voltage are in agreement only when the ozone generator is considered as nonlinear active-capacitive resistance. This prevents emergency modes during automatic system switching.

Key words: transient and steady-state electrical processes, transformer–air ozonizer system, equivalent circuit model of transformer–air ozonizer, automatic system switching.

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DEVELOPMENT OF AN AUTOMATIC MICROCLIMATE CONTROL SYSTEM IN AN INCUBATION CHAMBER

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Abstract. In the context of geopolitical instability and sanctions, Russia is striving to minimize its dependence on imported hatching eggs. The development and improvement of new modern incubators and their operating modes, which allow for the management of incubation processes in order to increase capacity of egg hatching, are urgent tasks. Therefore, the research purpose is to modernize the microclimate control scheme in the incubation chamber, to develop an algorithm and a microcontroller program for automatic control of parameters, taking into account the incubation period. To achieve the goal of the work, the microcontroller control scheme was modernized. An algorithm and a program for regulating the microclimate parameters of the incubation chamber, taking into account the incubation period, were developed in the C++ programming environment. The advantage of the system is its ability to regulate and maintain the microclimate parameters in the incubation chamber, depending on the growth and development of the embryo. According to the studies of some researchers, the air composition, specifically carbon dioxide and oxygen levels, directly and indirectly influences embryonic development. The direct impact is made on the growth, hatchability, and embryonic development pathologies. The proposed algorithm enabled the development of a control program for the incubation unit. The program provides the user with an interface for setting incubation parameters through an LCD display and a button. The advanced control program provides an opportunity to regulate and maintain the microclimate in the incubation unit, namely it maintains the air and egg surface temperature at no more than +38.3°C with an accuracy of $\pm 0.1^\circ\text{C}$, it also controls humidity and carbon dioxide levels at 2500 ppm, with an accuracy of ± 50 ppm, depending on the embryo's growth and development.

Key words: incubator, control program, program operation algorithm, microclimate, egg incubation.

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