Original article

ADAPTIVE STATUS OF LINUM USSITATISSIMUM L. GENOTYPES IN THE NORTHERN FOREST-STEPPE ZONE OF THE TYUMEN REGION

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Abstract. The identification of adaptive flax genotypes and their use as source material is of great significance in the strategy of creating new varieties, and it is also necessary to consider the complex interaction between the genotype and the environment. The aim of the study was to determine the potential of flax genotypes in terms of morphological and adaptive indicators when grown in different environmental conditions. The testing of hybrid lines (n = 18) was conducted in the Nizhnetavdinsky district of the Tyumen region. Based on the ANOVA analysis of variance, reliable differences between the flax genotypes were established according to the following criteria: field germination of seeds (FG, %, $p \leq 0.05$, $p \leq 0.01$, n = 3); plant height (PH, cm, $p \leq 0.05$; n = 3); stem mass (SM, mg, $p \leq 0.05$, n = 5); fiber content (FC, %, $p \leq 0.05$; n = 4); number of capsules per plant (NC, pcs., $p \leq 0.05$; n = 6); number of seeds in 1 capsule (NS, pcs., $p \leq 0.05$, n = 7). The structure of the complex interaction between the genotype and the environment (GxE) on the basis of AMMI analysis was revealed and a high reliable proportion of components (IPCA1, IPCA2) in terms of the studied morphological and biological indicators and properties was established. Promising genotypes were selected by the field germination of seeds (G1, G9, G11), by the plant height (G1, G5, G15), by the stem weight (G1, G3, G18), by the fiber content (G1, G4, G5), by the number of capsules per plant (G3, G9, G12), and by the number of seeds in a capsule (G1, G7, G15), which can be used in further selection and genetic research in the Tyumen region.

Key words: fiber flax, hybrid line, adaptability, multivariate analysis of variance, AMMI method.

For citation: Korolev K. P., Yakubenko A. N., Sobirzhonov D. B. Adaptive status of Linum ussitatissimum L. genotypes in the northern forest-steppe zone of the Tyumen region. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2 (82): 5-13. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_5-13.

Original article

FEED PRODUCTIVITY OF CORN DURING FOLIAR TREATMENT OF CROPS

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Abstract. Corn is the main silage crop in the Udmurt Republic. It has a high adaptive potential and productivity, effectively uses soil and climatic factors, and reacts positively to improving the nutrient regime of the soil. Currently, new types of fertilizers and biologically active preparations have appeared that allow corn hybrids to maximize their genetic

potential. The new preparations include microelements, amino acids, and stimulating additives in addition to traditional macronutrients. The aim of the work is to evaluate the effectiveness of foliar treatment in the formation of feed productivity of corn. The studies on foliar treatment of Cascade 166 ACB corn crops were conducted on sod-medium podzolic medium loamy soils in the Michurin collective farm in the Vavozhsky district of the Udmurt Republic in 2016-2018. The corn crops in the 5-6 leaf phase were treated with liquid complex mineral fertilizers Agree's Aminovite (1.4 l/ha), Agree's Azot (3 l/ha), Agree's AzotKaliy (3 l/ha), Agree's Magniy (2.5 l/ha), Agree`s Zink (2.5 l/ha), microbiological preparations Azotovite and Phosphatovite (1 l/ha + 1 l/ha), as well as with tank mixtures of complex mineral fertilizers and microbiological preparations. The control variant was without treatment. On average, over three years of research, it was found that foliar treatment of Agree's Azot (3 l/ha) + Azotovite (1 l/ha) and Phosphatovite (1 l/ha), Agree's AzotKaliy (3 l/ha) + Azotovite (1 l/ha) and Phosphatovite (1 l/ha) provided the crude protein yield 1.71-1.84 t/ha, the maximum yield of feed units 16.0-16.4 thousand units/ha and the metabolic energy 176.8-179.9 GJ/ha.

Key words: corn, foliar treatment, complex mineral fertilizers, microbiological preparations, crude protein, metabolic energy, feed units.

For citation: Ryabova T. N. Feed productivity of corn during foliar treatment of crops. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2(82): 14-18. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_14-18.

Original article

BIORESOURCE COLLECTION OF FLAX AT THE DEPARTMENT OF GENETICS, BREEDING AND SEED PRODUCTION IN RSAU-MOSCOW TIMIRYAZEV AGRICULTURAL ACADEMY

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Abstract. The Department of Genetics, Breeding and Seed Production of the RSAU-MAA named after K. A. Timiryazev conducts long-term studies of bioresource collection of oil and fiber flax. In 2021 this collection had more than 45 samples of various ecological and geographical origin. In order to implement breeding programs for this crop, the researchers actively began to extend the bioresource collection. Flax is cultivated to produce fiber and oil, which makes it a valuable technical and oilseed crop at the same time. The area under flax crops in the modern agro-industrial complex of the Russian Federation is increasing significantly every year, which is due to the multipurpose use of this crop. Flax is unpretentious to growing conditions, that is why creating regional bioresource collections is an achievable way for providing primary genetic diversity of the collection. Over the years of studying the collection, some oilseed flax varieties had a relatively high yield for the Central region of the Non-Chernozem zone (Raduga – 14.37 c/ha, Nebesnyi – 14.33 c/ha), the oil yield was more than 5 c/ha (Raduga – 6.11 c/ha, Nebesnyi – 6.02 c/ha). Some fiber flax varieties had a fiber yield of over 30 % (Rosinka, Fakel, Diplomat in 2022, Fakel in 2023). Hybrid populations of fiber flax have been created and studied. Among these

populations, the hybrid population Nadezhda x Rosinka turned out to be the best in the first generation according to the results of the index assessment F1 (the complex index is 1.42). The integrated evaluation was applied for the assessment F2, the most valuable population turned out to be the Fakel x Diplomat sample (SD = .02). Thus, we have gathered a flax collection consisting of both original varieties and hybrid flax populations, this collection is actively being studied and it is also a promising resource for the creating regional varieties in the conditions of the Central region of the Non-Chernozem zone.

Key words: oil flax, fiber flax, bioresource collection, wild species, gene pool.

For citation: Simagin A. D., Simagina A. S., Vertikova E. A., Barnashova E. K., Vilkhovoy Ya. E. Bioresource collection of flax at the Department of Genetics, Breeding and Seed Production in RSAU-Moscow Timiryazev Agricultural Academy. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2(82): 19-28. (In Russ.). https:// doi.org/10.48012/1817-5457_2025_2_19-28.

Original article

STUDYING THE POSSIBILITIES OF INCREASING THE CORN GRAIN YIELD

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Abstract. The article presents the results of studies on changes in the corn grain yield after the application of mineral fertilizers for the target grain yield of 6.2 t/ha (background) and with the application of liquid complex fertilizers Megamix-Profi, Megamix-Azot and the growth regulator Albit in the phase of 3-4; 3-4 + 5-6 and 5-6 leaves on leached chernozems of the Mordovian Research Institute of Agriculture of the Republic of Mordovia on average for 2022 – 2024. We have found that the plant density before harvesting (56.44 – 59.64 thousand/ha) and the proportion of grain in the cob (78.2 – 80.2 %) did not increase significantly in the studied variants. The use of solid fertilizers, as well as "new agrochemicals" during the vegetation period of plants, led to an increase in the grain content (by 18.8 – 32.4 %) and the weight of grain per cob (by 15.5 – 42.2 %), the weight of 1000 seeds (by 8.2 – 14.2 %), compared to the unfertilized background (414 pcs., 90.3 g and 218 g). All studied variants demonstrated the higher grain yield (by 2.49 – 3.48 t/ha or 48.5 – 67.8 %) than the control variant (5.13 t/ha), however, spraying with Megamix-Profi, Megamix-Azot and Albit did not contribute to a significant yield increase relative to the variant with the use of mineral fertilizers for the target grain yield of 6.2 t/ha.

Key words: corn, plant density, number and weight of seeds per cob, yield.

For citation: Khnykin T. V., Yeryashev A. P. Studying the possibilities of increasing the corn grain yield. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2 (82): 28-35. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_28-35.

Original article

STATE OF SPRUCE STANDS IN THE UDMURT REPUBLIC UNDER THE CHANGING CLIMATE

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Abstract. The article analyzes the sanitary conditions of spruce stands on the basis of data of eight sample plots laid out with the use of widely known and approved methods of forest taxation, as well as the Rules of Sanitary Safety in forests, in the southern taiga forest region of the European part of the Russian Federation within the boundaries of the Udmurt Republic. It has been established that spruce stands differ significantly in their sanitary conditions. However, a significant volume of dead wood is the common feature. The drying out of spruce trees occurred primarily due to a lack of precipitation and high air temperatures during the previous three vegetation periods. The weakening of spruce trees caused by drought led to the mass reproduction of European spruce bark beetle (Ips typographus L.), which at first damaged weakened trees, and there were grounds to assert that after the mass reproduction it began to populate healthy spruce trees. The state of spruce stands necessitates the adoption of urgent measures to improve sanitary conditions. The current situation is explained primarily by the untimely implementation or complete absence of selective sanitary fellings. The most preferred time for selective sanitary fellings is winter. When carrying out selective sanitary fellings it is necessary to place logging residues on skidding trails in order to minimize the risk of damaging the roots of remained trees.

Key words: Udmurt Republic, spruce stands, drought, European spruce bark beetle, sanitary state.

For citation: Agafonova T. N., Iteshina N. M., Zalesov S. V. State of spruce stands in the Udmurt Republic under the changing climate. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2 (82): 36-42. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_36-42.

Original article

IMPACT OF MYCORRHIZAL SYMBIOSIS WITH SUILLUS SPECIES ON THE ADAPTIVE PROPERTIES OF PINUS SYLVESTRIS L. AND ON THE SUPPRESSIVE PROPERTIES OF SOIL AGAINST HETEROBASIDION ANNOSUM (FR.) BREF.

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Abstract. Studies of the influence of mycorrhiza on the suppressive properties of soil against root fungus are especially relevant in the context of sustainable forestry and forest

protection. The aim of the study was to assess the influence of mycorrhizal associations of fungi of the genus Suillus with trees Pinus sylvestris L. on the suppressive properties of soil against Heterobasidion annosum (Fr.) Bref. in a test plot in the Seedling Nursery Complex of the Voronezh Region in 2024. The objects of the study were 3-year-old pine seedlings, mycelia of Suillus bovinus and Suillus luteus fungi in the substrate and soil samples of the mycorrhizosphere of the studied pine seedlings, taken from a depth of 0-20 cm. Soil suppressiveness was determined by using the method of Tropova E. Yu. and Kirichenko A. A. Based on the data obtained, it has been established that the introduction of mycorrhizal preparations Suillus bovinus + Suillus luteus and Suillus luteus contributes to an increase in soil suppressivity by 18.4 % and 12.5 %, respectively. The introduction of Suillus bovinus is ineffective. The positive effect of the introduction of the considered mycorrhizal preparations on pine seedlings nutrition is due to the increase in the number of microbial communities. The samples with mycorrhiza Suillus bovinus, Suillus bovinus + Suillus luteus and Suillus luteus had an increase in oligoazophiles compared to the control sample by 42 %, 33 % and 49 %, respectively, diazotrophs y 85 %, 81 % and 87 %, nitrogen immobilizers y 34 %, 42 % and 37 %, ammonifiers y 23 %, 34 % and 23 %, actinomycetes by 80 %, 80 % and 66 %. The introduction of mycorrhizal preparations Suillus bovinus + Suillus luteus and Suillus luteus had a positive effect on the morphometric parameters of pine seedlings: it increased the height of seedlings by 13 % and 18 %, respectively, and the length of needles by 27 % and 20 %, respectively.

Key words: mycorrhiza, soil suppressiveness, root fungus, Scots pine, Suillus bovinus, Suillus luteus.

For citation: Arnaut Yu. I. Impact of mycorrhizal symbiosis with Suillus species on the adaptive properties of Pinus sylvestris L. and on the suppressive properties of soil against Heterobasidion annosum (Fr.) Bref. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2 (82): 42-50. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_42-50.

Original article

FRACTIONAL STRUCTURE OF PHYTOMASS IN THE TREE PLANTINGS OF VLADISLAV AGAFONOV PARK IN YEKATERINBURG

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Abstract. Parks are an integral part of the landscaping system of the city of Yekaterinburg, performing a recreational function for residents of its districts. Parks were often created on the site of natural plantings during the development of the urban environment; in this case the local species were supplemented with decorative introduced species. In the city's parks, pine plantations are the most ecologically active, they emit an average of 30 tons of oxygen per year, which is much higher than deciduous ones. This paper considers the phytomass to be a criterion of ecological significance. The purpose of the work is to analyze the structure of phytomass of coniferous and deciduous trees in the Park named after V. Agafonov in Yekaterinburg. Two approaches for determining the phytomass of trees were applied in the calculation. In the first case, the allometric

dependencies established in the taxation were used. According to the second method, only the phytomass of the trunk was determined based on the volume index and the average values of wood density. As a result of the research, it has been concluded that in the total aboveground phytomass of the entire studied plantation, Scots pine has the largest share (84 %), and the mass of the assimilation apparatus and the phytomass of the trunk significantly exceed the values of other woody species, including introduced ones. The trunk mass indicators determined by various methods are approximately the same. Accordingly, the trunk mass can be set based on the volume index and the average values of wood density, and the crown mass can be set according to allometric functions, which greatly simplifies the research. In the conditions of Yekaterinburg, Scots pine will be one of the most productive tree species that should be used in the green space system.

Key words: urban parks, landscaping system, methods for determining phytomass.

For citation: Atkina L. I., Zhukova M. V., Morozov A. M., Suslov A. V., Suslova N. G. Fractional structure of phytomass in the tree plantings of Vladislav Agafonov Park in Yekaterinburg. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2 (82): 50-56. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_50-56.

Original article

IMPACT OF NATURAL STIMULANTS ON ROOTING OF MOCK ORANGE (PHILADELPHUS SPP.) CUTTINGS

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Abstract. The article presents the research results of the effectiveness of plant growth stimulants in the vegetative propagation of four species of mock oranges: sweet mock orange (Philadelphia coronaria L.), Aureus sweet mock orange (Philadelphus coronarius Aureus), Schrenk's mock orange (Philadelphus Schrenkii Rupr. et Maxim.), and littleleaf mock orange (Philadelphus microphyllus A. Gray). The experiments on plant propagation were conducted by leaf-cuttings and using growth stimulants (auxins) Indole-3-butyric acid (IBA) and Indole-3-acetic acid (IAA) at various concentrations (7 experimental variants and the control variant). A statistically significant effect on the rooting success of Philadelphus species was established for the following factors: growth stimulators, taxa, and their interaction. Growth stimulators were identified as the key factor influencing rooting (η^2 = 0.463). The most efficient was the IBA treatment at concentrations of 5 mg/l and 25 mg /l, which resulted in rooting rates of 75 % to 100 % for all species. At the same time, IAA treatment was less effective. During all experiments the Aureus sweet mock orange had the highest rooting rate, while the minimal effect of the stimulants occurred in the littleleaf mock orange. The rooted plants developed a robust, branched root structure.

Key words: ornamental shrub, mock orange, propagation, cutting, growth stimulant, auxin, rooting.

For citation: Krekova Ya. A., Chebotko N. K., Zalesov S. V. Impact of natural stimulants on rooting of mock orange cuttings. The Bulletin of Izhevsk State Agricultural

Academy.2025; 2 (82): 57-64. (In Russ.). https://doi. org/10.48012/1817-5457_2025_2_57-64.

Original article

REFORESTATION DURING ALTERNATE STRIP GRADUAL FELLINGS IN SORREL FORESTS OF THE CONIFEROUS-BROADLEAF FORESTS ZONE

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Abstract. The article is devoted to the study of accompanying natural regeneration when conducting alternate strip gradual fellings in pine plantations growing in relatively rich soil conditions of sorrel and dead nettle, bracken and linden forest types. Mature and overmature pine plantings growing in the studied group of forest types were examined in the research area. After selecting the plots, the first alternate strip gradual fellings were carried out on them. Upon completion of logging operations on the felled strips, partial mineralization of the soil was carried out in the spring with a PKL-70 plow, the distance between the centers of the furrows was 3.5 m. Two years after the logging, the felled strips were examined, the natural regeneration of tree and shrub vegetation and the parcel structure of the forest live cover were analyzed. The density of forest renewal with commercially valuable species was 2.4 – 5.2 thousand units/ha. This is sufficient for forming a young forest with a predominance of pine trees. The young growth of pine was mainly represented by plantings of accompanying reforestation, and spruce by plantings of preliminary reforestation. The forest live cover was represented by 40 species and consisted of such plants as bush grass, raspberry, sedge grass, goutweed and others. Already in the second year after logging, the tall grass canopy and vegetative shoots of raspberries, roebuck berries, strawberries, goutweed prevented the appearance of pine self-seeding even in the mineralized part. By the third or fourth year after logging, the negative effects of undergrowth began to manifest themselves. Its crowns, along with the reforestation of hardwoods, closed in on a plot area of up to 20 %. Thus, soil mineralization should be carried out in the first spring season after logging, and in the future, based on the results of an analysis of the condition of the felled strips, it is recommended to carry out the forest tending. With proper implementation of these measures, it is possible to form stable stands of trees with a predominance of pines. At the legislative level it is necessary to introduce amendments into the Forest Regeneration Rules (2021). The cut-down strips of alternate strip gradual fellings should be entered into the reforestation fund and the parameters of the activities carried out in such areas should be determined.

Key words: alternate strip gradual fellings, natural reforestation, forest regeneration rules, sorrel group of forest types, protective forests.

For citation: Nikitin D. V., Perepechina Yu. I., Mikhailov N. A., Erohin A. V. Reforestation during alternate strip gradual fellings in sorrel forests of the coniferous-

broadleaf forests zone. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2(82): 65-73. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_65-73.

Original article

FEATURES OF THE ASH SHARE IN TREE-STAND COMPOSITION IN NATURAL AND PLANTED KALUGA FORESTS

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Abstract. The common ash is one of the valuable tree species in the Kaluga forests, its percentage varies quite significantly in natural and planted forests. The occurrence of this tree species in forestry plantations reaches 7 %. As for planted forests, natural successive processes are significantly adjusted by human activity, which leads to changes in phytocenosis. Common ash is rarely brought under cultivation, therefore it is of interest to identify the features of the dendrological composition of the canopy of forming plantations with this tree species. From 5 to 6 different tree species are most commonly noted in the tree-stand composition. The probability of birch frequency in mixed plantations with common ash is 87.8 %; aspen 77.6 %; linden 73.1 %; maple 71.7 %; oak 70.6 %; spruce 35.4 %; elm 22.6 %; black alder 11.6 %; pine 2.5 %. The features of differences in the species composition of natural and planted forests with common ash have been revealed: the most significant differences are observed in the proportions of the following tree species (in descending order of importance): spruce, oak, maple, linden, aspen, birch, black alder, pine. The main forest-forming species such as spruce, pine and oak are artificially introduced in the corresponding forest growing conditions at forestry enterprises of the Kaluga Region. Other species are renewed naturally, which leads to the formation of plantations in a combined way – with the help of artificial and natural regeneration. The dendrological spectra of plantations of natural and artificial origin with the ash share turned out to be different. The significantly higher proportion of spruce is noted among species, the lower proportion of aspen and linden, and the complete absence of black alder compared to artificial plantings.

Key words: common ash, share, forest management information, forest-forming species.

For citation: Plotnikova D. S., Marchenko S. I. Features of the ash share in tree-stand composition in natural and planted Kaluga forests. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2 (82): 74-80. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_74-80.

Original article

DYNAMICS OF WEB-SPINNING SAWFLY FOCI AND ITS IMPACT ON THE STATE OF PINE FORESTS IN THE BRYANSK REGION

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Abstract. The first foci of the pest that had not previously been noted in the focal number – the web-spinning sawfly began to appear on the territory of the Bryansk region. The pest centre was first discovered on the territory of the Educational and Experimental Forestry in September 2009. Over the past 15 years, the area of foci of the web-spinning sawfly has increased 47 times. The object of the study is the pine plantations of the Fokinsky forest range of the Bryansk Forestry, which are exposed to the negative effects of phyllophages. The forest pathology examination was carried out using standard methods. During a detailed examination, soil diggings were carried out in each allotment, where temporary sample plots were laid. The survey was conducted in late April arly May 2024. In total, 22 temporary sample plots were laid in high-bonitat, multiple-aged plantations of various forest density with varying proportions of pine and the degree of crown overeating. To analyze the population indicators of the sawfly, 3 pits were laid on each sample plot. The total area of pest foci was 2337 hectares in 2023. The sawfly mainly damages high-bonitat pine forests with high and medium forest density, with the species share in the composition (8-10 units) of the IV age class. As for the condition of the studied plantings, they are weakened and severely weakened. The main reason for the weakening of pine plantations is the web-spinning sawfly. According to the data of soil diggings, at the time of the survey, almost the entire population was developing without long-term diapausation. The largest number of registered individuals were healthy. The parameters of the web-spinning sawflies recorded in the Fokinsky forest range of the Bryansk region differ from previously published data for other regions.

Key words: sanitary condition, pest foci, web-spinning sawfly, phyllophages, needle-gnawing pests, forest pathology examination.

For citation: Proskurnina I. N., Shelukho V. P. Dynamics of web-spinning sawfly foci and its impact on the state of pine forests in the Bryansk region. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2(82): 81-88. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_81-88.

Original article

EFFICIENCY OF FOREST PLANTATION DEVELOPMENT BY HOLE PLANTING

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Abstract. The purpose of the research is to analyze the prospects of forest-forming species for the development of forest plantations by the method of hole planting in the highlands of the Ak-Suu gorge of the Tien Shan of the Kyrgyz Republic. The survival rate of forest plantations of Schrenk's spruce (Picea schrenkiana F. et M.), cascade fir (Abies

amabilis Parl.), Siberian fir (Abies sibirica Ledeb.), blue spruce of green form (Picea pungens Engelm.), Crimean pine tree (Pinus pallasiana D. Don.), and Scots pine (Pinus selvestris L.) was analyzed during the research. One year after the planting of forest crops of the above-mentioned species, their survival rate and average growth in height of the central shoot were determined. The best survival rate was shown by cascade fir, blue spruce of green form and Crimean pine tree. In high-mountain conditions on slopes with a steepness of more than 10° of south-eastern exposure, Schrenk's spruce and Siberian fir turned out to be unstable and were characterized by extremely low survival rate. In addition to unfavorable forest growing conditions, wild and domestic ungulate animals have a significant impact on the survival rate of planted forest crops. Considering the importance of the research conducted for forest restoration in the Kyrgyz Republic, the work should be continued by increasing the range of species used in the creation of forest crops.

Key words: Kyrgyz Republic, forest restoration, forest crops, hole planting, survival rate.

For citation: Chyngozhoev N. M., Arstanbekuulu N., Manasova J. I., Zalesov S. V. Efficiency of forest plantation development by hole planting. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2 (82): 89-97. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_89-97.

Original article

REGULARITIES OF SURFACE RUNOFF FORMATION TO JUSTIFY THE DESIGN OF AGROFORESTRY RECLAMATION TECHNIQUES AND STRUCTURES IN THE VOLGA UPLAND STEPPE

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Abstract. The purpose of this study is to establish patterns of spring and storm runoff formation for the design of agroforestry erosion control techniques and structures. The experiments were performed according to the methods of the State Hydrological Institute (SHI), All-Russian Research Institute of Agroforestry. To justify the design of soil erosion protection techniques, the curves of probability of exceeding the spring and storm runoff on special fiber recommended by the SHI were constructed. The experiments have shown that the volume of runoff in summer is less than in spring: in agricultural landscapes to 76.5 %, in forests – up to 5 times, and the runoff module of rain floods, on the contrary, is more than meltwater up to 87.5 %, depending on the probability of exceeding. In the conditions of the Volga Upland steppe, the water-retaining anti-erosion techniques (shafts, forest strips reinforced with shafts-ditches etc.) should be justified by the values of spring runoff, and the discharging facilities (fast flows, mine spillways etc.) by the values of the storm runoff module. The values of storm runoff of rare probability of exceeding (1-10 %) in agricultural landscapes are higher than the corresponding indicators of the Kurdyum River up to 81.8 %, and on average up 3.6 times. A correlation was established at the level of 97 % of the maximum rainstorm flow rate from the slope, the watershed area. The constructed diagrams of spring and storm runoff made it possible to recommend the appropriate values for the

design of complexes of anti-erosion agroforestry activities. It is recommended to design: 1) water retaining structures for spring runoff with a probability of exceeding 10 %, which is 55 mm in agricultural landscapes runoff, and 30 mm in forests runoff; 2) discharging structures for the storm runoff module with a probability of exceeding 1 % – 3.0 m3/s·km2, 10 % – 1.7 m3/s·km2, 20 % – 1.3 m3/s·km2.

Key words: the Volga Upland steppe, agroforestry reclamation, spring and storm runoff, modules of spring and storm runoff, probability of exceeding, regression, correlation.

For citation: Yashin I. P., Eskov D. V., Proezdov P. N., Mashtakov D. A., Rozanov A. V. Regularities of surface runoff formation to justify the design of agroforestry reclamation techniques and structures in the Volga Upland steppe. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2(82): 98-104. (In Russ.). https://doi. org/10.48012/1817-5457_2025_2_98-104.

Original article

THE STATE AND DYNAMICS OF ANIMAL HUSBANDRY IN THE TYVA REPUBLIC

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Abstract. The Republic of Tyva is situated in the zone of risky agriculture, therefore the improvement and rational use of forage lands as a factor in the continuous development of the livestock industry is an urgent task. The purpose of the research was to analyze the state of livestock production in the Republic of Tyva for ensuring food security in the region. The agriculturally used areas, the number of farm animals, the structure, production and consumption of livestock products by the population in the republic were studied. Statistical data provided by the territorial body of the Federal State Statistics Service for the Krasnoyarsk Territory, the Republics of Khakassia and Tyva were used as the initial information for the analysis. 175 agricultural organizations operate in the Republic of Tyva. In 2024 livestock products account for 80% of agricultural production. As for the dynamics of the number of farm animals in the Republic of Tyva, the number of cattle decreased by 6.0 %, and there was a positive trend in the increase in the number of horses by 9.2 %. There was a significant decrease in the number of sheep and goats by 43.0 %, and pigs by 68.8 %. compared to 2020. The production of basic livestock products in slaughter weight increased by 9.4 %, but poultry production decreased by 66.0 % and pigs by 9.4 %, milk by 9.4 %, eggs by 38.3 %. Along with the reduction in livestock numbers, it should be noted their low productivity, especially dairy productivity, which is associated with a low supply of animal feed and the quality of harvested feed. Serious consideration should be paid to improving the regionalization of animal breeds by zones and regions of the republic.

Key words: Republic of Tyva, agriculture, animal husbandry, number of livestock, livestock products, categories of farms, peasant farms, agricultural organizations.

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Agricultural Academy. 2025; 2 (82): 105-112. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_105-112.

Original article

PRODUCTIVITY INDICATORS AND AMINO ACID CONTENT IN MILK FROM DAUGHTERS OF DIFFERENT BULL BREEDS

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Abstract. The article presents data on the milk productivity and amino acid content of the milk of daughters of Holstein bulls of various breeding. To study the productivity and amino acid composition of milk, four groups of cows of daughters of Holstein bulls of various breeding were formed. Group 1 included animals of Dutch breeding, group 2 – Danish, group 3 – Canadian and group 4 – Russian breeding. The amino acid content of milk proteins was determined on a T-339 analyzer. The highest milking capacity was found in the daughters of Canadian-bred bulls, the lowest – in the daughters of Russian-bred bulls, the difference was 623 kg (P≥0.95). The difference between the offspring of Russian and Dutch bulls was 461 kg and between the offspring of bulls of Russian and Danish breeding – 275 kg with an insignificant difference. The daughters of Dutch-bred bulls are distinguished by a high protein content in milk (3.49 %), surpassing their herd mates in this indicator by 0.08, 0.15 and 0.22 %. The daughters of Canadian-bred bulls received the lowest protein values of 3.27 %. The average protein content in cow's milk during the period of determining the amino acid composition (4-5 months of lactation) ranged from 3.34 to 3.60 %. Due to the higher content of essential amino acids (leucine, lysine, and valine) and nonessential amino acids (glutamic acid, proline, alanine, and tyrosine) in the milk of Dutch-bred cows, they significantly exceed the cows of Canadian and Russian breeding in terms of the total amino acids by 0.25-0.29 (P≥0.95). Dutch-bred cows have the highest biological value of milk protein (I=0.870 and I1=0.465), followed by Russian-bred cows with biological value of milk protein (I=0.866 and I1=0.464), further followed by Danish-bred cows (I=0.856 and I1=0.461) and Canadian-bred cows (I=0.813 and I1=0.448).

Key words: breed, genotype, milk yield, fat, protein, amino acid, breeding, milk, productivity.

For citation: Velmatov A. P., Gibalkina N. I., Tishkina T. N. Productivity indicators and amino acid content in milk from daughters of different bull breeds. The Bulletin of Izhevsk State Agricultural Academy.2025; 2 (82): 112-117. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_112-117.

Original article

EXPERIENCE OF USING AN ENZYME PREPARATION WITH ENHANCED ANTIOXIDANT EFFECT IN HONEYBEE NOSEMATOSIS

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Abstract. Various infectious and invasive diseases have a negative impact on the physiological state of bees forming a family and cause significant economic losses in beekeeping. In recent years, nosematosis has attracted attention, causing mass deaths of bee colonies and a decrease in their productivity, reaching up to 10-30 % in the case of family damage by 30 %, up to 70-100 % – with a family infection rate of 40 %. In this regard, the goal was set to determine the impact of an enzyme and vitamin complex with an antioxidant effect on economic traits of bees infected with nosematosis. The studies on the selection of the optimal dosage of active substances in the enzyme-vitamin complex were conducted in the laboratory "Processing Livestock Products" of the Udmurt State Agricultural University; the field tests for the establishing the effectiveness of the biological product for economic traits of European dark bees were conducted in a stationary apiary of the Udmurt Republic in 2023-2024. The experimental bee colonies were fed with the sugar syrup enriched with a biological product with an antioxidant effect developed on the basis of a high–molecular enzyme, superoxide dismutase, and rosehip decoction. The enzyme-vitamin detoxification system of bee colonies of the experimental groups had a positive effect on the average daily egg production of queen bees, on the volume of gross honey production and on the degree of weakening of bees over the winter period: the indicators exceeded similar values in the control group by 11.8-20.2 %, 11.4-22.9 % and 2.8-4.2 %, respectively.

Key words: honey bee, cage experiments, antioxidant enzyme, vitamins, nosematosis, egg production, honey productivity, winter hardiness.

For citation: Vorobyova S. L., Vasilyeva M. I., Fedorova A. S. Experience of using an enzyme preparation with enhanced antioxidant effect in honeybee nosematosis. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2 (82): 117-124. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_117-124.

Original article

EFFECT OF ELECTROMAGNETIC RADIATION ON INTERNAL ORGANS OF BROILER CHICKENS: MORPHOLOGIC AND HISTOLOGIC CHANGES

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Abstract. The aim of the research is to identify the effect of electromagnetic radiation on morphological and histological changes in the internal organs of broiler chickens. The studies were conducted on 100 broiler chickens of Cobb 500 cross during the period from one day old to 56 days old in May-June 2024. The chickens were distributed into two groups of 50 chickens in each group by the groups-analog method. Feeding and housing conditions met all the requirements for this cross of poultry in floor housing. The experiments were performed in accordance with the requirements of the European Convention for the

Protection of Vertebrate Animals Used for Experiments or Other Scientific Purposes (ETS No. 123, Strasbourg, 1986). The chickens had free access to feed and water. There were 3 periods in the feeding of the chickens: the starter period (0-10 days), the growth period (15-21 days) and the finishing period from day 22 until slaughter. After euthanasia, internal organs (heart and liver) were extracted for subsequent morphometric and microscopic studies. The poultry treatment regimens during the rearing period were as follows: treatment was started at the age of 4 days. On days 4, 5 and 6 chickens were treated once at 8.00 am for 3 minutes. On days 7, 8 and 9, the treatment was increased to three times starting from 8.00 to 10.00 am. The treatments lasted for three minutes each hour. From 10 days old to 35 days old, chickens were treated from 8.00 am to 6.00 pm for three minutes each hour. From 35 days of age to the end of rearing, chickens were treated from 08.00 am to 8.00 pm for three minutes every half an hour. Histologic analysis revealed no changes in the structure of tissues and organs in both the control and EMI-exposed groups. The use of non-ionizing non-thermal exposure to EMR does not have a negative effect on internal organs, does not represent a danger and, therefore, is safe for use in poultry farming.

Key words: broiler chickens, electromagnetic field, histology, liver, heart.

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Original article

COMPARATIVE TESTING OF MEAT AND WOOL RAMS IN INDUSTRIAL CROSSBREEDING

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Abstract. Sustainable agricultural development based on innovations and scientific research is becoming a key factor in increasing the competitiveness of Russian producers. The purpose of this study is to determine the efficiency of using meat and wool rams in the process of industrial crossing in order to increase the productivity of lambs. This includes the study of different sheep breeds and their impact on the characteristics of offspring, as well as an assessment of the economic feasibility of such activities. The methods of industrial crossbreeding, control fattening and statistical data analysis were applied in the research. The experiments were carried out with three groups of rams obtained from different breeds: Altai sheep, Soviet meat and wool sheep of Siberian type, and Texel sheep. During the experiment the dynamics of live weight, meat productivity, exterior characteristics and economic efficiency were evaluated. The results of the study demonstrated that the crossbred ram-lambs obtained from meat and wool rams showed a significantly better conversion of feed into live weight gain compared with the offspring from Altai sheep. The highest rates were recorded in ram-lambs bred from Texel breed

producers, which indicates the high potential of this breed to improve meat productivity. In addition, cross-bred ram-lambs were superior to fine-fleeced sheep in a variety of important parameters, including growth rate, development, meat productivity and exterior characteristics. This opens up new horizons for selective work in sheep breeding. The results of this study can become an important tool for Russian sheep breeders, allowing them to choose the optimal breeds for crossing. This, in turn, will lead to an increase in sheep productivity and an improvement in meat quality, which will contribute to the development of economic efficiency of sheep farming, which is of particular importance in modern market conditions.

Key words: industrial crossbreeding, lamb, meat and wool breeds, Soviet meat and wool breed, Siberian type, Texel breed, Altai breed, control fattening, live weight gain, feed conversion by increment.

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Original article

MILK PRODUCTIVITY IN HOLSTEIN COWS DEPENDING ON THE TYPE OF PARENTS SELECTION

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Abstract. The indicators of milk productivity of Holstein cows bred from different types of parents selection have been studied. The research was carried out on the basis of a breeding plant for Holstein cattle breeding in the Udmurt Republic. To determine the type of selection, the data of 579 daughter cows with known productivity of female ancestors were taken into account. The type of selection was determined based on the differences between the productivity of mothers and mothers of fathers at the highest lactation, taking into account the value of the standard deviation in maternal milk yield (σ). The information base for the research was the data from the primary zootechnical accounting and the IAS "Selex airy cattle". As a result of the research, it has been revealed that homogeneous (30.0 %) and moderately homogeneous selection (30.6 %) are the most common in the herd, the frequency of heterogeneous selection was 17.6 % and moderately heterogeneous selection – 21.8 %. It has been established that the amount of milk yield depends on the types of selection of parents. The highest milk yield was observed in groups of cows bred from moderately homogeneous (11159.9 kg) and heterogeneous (11148.9 kg) selection of parents. They outperformed their herd mates from homogeneous selection by 572.6–561.6 kg of milk, and from moderately heterogeneous selection – by 248.7–259.7 kg of milk. The mass fraction of fat in the milk of cows with different types of selection was in the range of 3.79–3.81 % and had no significant difference. The mass fraction of protein in cow's milk was in the range of 3.18–3.19 %, while cows of all groups were inferior to their mothers by 0.01– 0.04 %.

Key words: selection, homogeneous, heterogeneous, moderately homogeneous, moderately heterogeneous, milk yield, mass fraction of fat, mass fraction of protein.

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Original article

CONTROL SYSTEM FOR RECIRCULATION OF DRYING AGENT IN AN AERODYNAMIC DRYER

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Abstract. The creation of simple, reliable, energy-efficient control systems for the drying agent is one of the key tasks in the design of new grain dryers. The aim of the study is to reduce the energy consumption for drying grain in an aerodynamic device for drying bulk materials by recirculation the drying agent in automatic mode. A recirculation system for the drying agent of an aerodynamic device for drying bulk materials and an automatic control system for its operation have been developed. Its operation is based on the principle of proportional control, maintaining the required relative humidity of the drying agent at the outlet of the grain layer by adjusting the position of the rotary flap of the four-way mixing valve. The automatic control unit for the flap of the mixing valve of the recirculation system of the drying agent of the aerodynamic device consists of a programmable relay with PR200 display, a personal computer with SimpLight software, an electric drive without a return spring Belimo GM 24, an industrial sensor – converter of humidity and air temperature HT110. The use of the developed heat recirculation system for the drying agent with an automatic control unit for the rotary flap of the mixing valve made it possible to reduce the integrated energy consumption by 35 %, to 5.07 MJ/kg. The developed system can be used in the design of various grain dryers, it reduces energy and labor costs and dustiness of the working area.

Key words: aerodynamic device, automatic control, recirculation system, recirculation, reuse, drying agent.

For citation: Volkhonov M. S., Kovalenko R. M., Zimin I. B. Control system for recirculation of drying agent in an aerodynamic dryer. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2 (82): 153-160. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_153-160.

Original article

DEVELOPMENT AND CHARACTERISTICS ANALYSIS OF INDUCTION ELECTRIC HEATING UNIT

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Abstract. High-frequency induction heating technologies are widely used in the processes of ultra-clean contactless melting, metal welding and heat treatment of complex machine parts, when processing small parts that can be damaged by gas flame or arc heating. The purpose of the study is to develop and study the characteristics of an induction electric heating unit. The objectives of the study are to develop a structural and basic diagram of the induction unit, and to conduct experimental studies of its characteristics. To study the induction heating modes, a laboratory setup was developed that allows measuring the temperature of the heated workpiece and the inductor; adjusting the current frequency; measuring the currents of the primary link and inductor; setting the maximum efficiency mode. During the experiment, the measurements of the temperature characteristic depending on time at different diameters of the workpiece and different inductor currents, and the measurements of the heating rate depending on the diameter of the workpiece at different inductor currents were carried out. The analysis of the studies allows us to conclude that with an increase in the diameter of the workpiece, the time of its heating to the set temperatures increases (within 150…350°C depending on the diameter of the workpiece). An increase in the inductor current at the initial moment of heating to 120 s slightly increases the temperature of the workpiece. With an increase in the heating time, an increase in the inductor current from 15 to 30 A increases the temperature of the workpiece by 30°C. The heating rate on a workpiece with a diameter of 17 mm with an increase in the inductor current by 1 A increases by 0.01°C/s, and on a workpiece with a diameter of 10 mm – by 0.08°C/s. Thus, the developed laboratory setup allows us to study the main operating parameters of induction heating, including the temperature characteristics of heating depending on the diameter of the workpiece and the inductor current. The results obtained can be used for designing and selecting the operating parameters of induction heating units.

Key words: induction heating, inductor, inductor current, specific power.

For citation: Lekomtsev P. L., Olin N. L., Artamonova L. P., Kutyanov O. B. Development and characteristics analysis of induction electric heating unit. The Bulletin of Izhevsk State Agricultural Academy. 2025; 2 (82): 161-168. (In Russ.). https://doi.org/10.48012/1817-5457_2025_2_161-168.

Original article

RESULTS OF STUDIES ON REGULATING THE LOAD ON THE WORKING BODY OF THE ROLLING UNIT

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Abstract. The basis of the future yield of cultivated crops largely depends on the soil density. Special agricultural machines are used for soil management – rollers, which make it possible to create a certain density by changing the load on the working body. At the same time, all kinds of additional loads, both active and passive (ballast), are very often used to regulate the load on the working body. In small peasant farms in the Amur region, in most cases, water-filling rollers are used with the so-called passive additional loading on the

working body (roller) by changing its mass. This imposes certain difficulties when it is necessary to change the mass (load on the working body) in order to achieve the required soil density. The purpose of the work is to develop and justify a technical solution for the possibility of adapting the trailed water–filled rollers to automatic load control on the working body. The research was carried out both in the laboratory and in the working environment of the Zhukovin Farm in the Amur region. The soil moisture was measured using a digital moisture meter PMS–710. The soil density was determined by a well-known method using a cutting cylinder. The soil hardness was determined using a digital soil hardness tester TYD-2. The MVSK(B) scales were used to determine the load on the working body of the rolling unit. VK-5000 crane scales were used to determine the force generated by the hydraulic cylinder and the cable connection. During the research a device was developed for automatically adjusting the load on the rolling unit. It has been established that when the length of the outlet of the hydraulic cylinder rod changes, the tension force of the flexible cable part changes, resulting in that the part of the load from the tractor is transferred to the working body of the rolling unit (roller). When the tension of the flexible cable part changed from 0 to 4190 N, the load on the working body of the rolling unit (roller) increased from 1059 N to 4070 N. The use of the proposed device enables to change the soil density from 1.13 to 1.35...1.40 g/cm3.

Key words: rolling, load, working body, density, soil, roller.

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