

Original article

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## SELECTIVE AND GENETIC PARAMETERS OF ASSESSMENT OF VYATKA BREED HORSES

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**Abstract.** Aboriginal horses are unique in their multipurpose use. The aim of the research is to evaluate the selective and genetic parameters of the Vyatka horse breed from different geographical populations. To compare zootechnical and genetic characteristics of horses the entire breeding stock was divided into three different geographical populations: the Udmurt Republic, the Kirov Region and the Central Federal District (CFD). The comparative assessment of horse population was carried out by the generally accepted methods in zootechnics. The genetic monitoring was carried out according to the pedigrees of the breeding stock, and studies were also carried out to identify the relationship between the genes of myostatin (MSTN), calpastatin (CAST) and prolactin receptors (PRLR) with constitution indices in the independent laboratory 'HorsGen' (Moscow). As a result representatives of the Central Federal District are the largest, the height at the withers of stallions averaged 148.7 cm, which is significantly more than in the Udmurt population by 2.8 % ( $P \geq 0.95$ ), the same trend was found in mares. In terms of chest circumference, the maximum indicator corresponds to stallions and mares of the Central Federal District, which is 11.3 cm and 9.8 cm, respectively, more than in stallions of the Kirov region ( $P \geq 0.99$ ). Horses of all analyzed populations have the format of draft horses. Thus, the highest format index was found in Vyatka horses of the Central Federal District – 108.9 % in stallions, 109.8 % in mares. Horses with the MSTN T/T genotype have the highest calculated index of boniness, the most massive and bony were horses with the heterozygous CAST G/A genotype. The relationship between the frequency of occurrence of PRLR genotypes and body types of horses has not been identified. The proportion of outbred horses is 43.3 %. The representatives of the breed in the Kirov region are outbred – 62.1 %, the population of the Udmurt selection mainly consists of horses with remote inbreeding – 43.4 %. Central Russia is mainly represented by outbred horses – 48.5 %. Thirty shows were organized with the participation of 251 heads of breeding horses of the Vyatka breed in 2016–2021.

**Key words:** Vyatka breed of horses, inbreeding in horse husbandry, DNA markers, measurements and indices, horse shows.

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## HIGH-YIELDING VARIETY OF MULTI-ROW BARLEY TEVKECH FOR CULTIVATION FOR FEEDING PURPOSES

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**Abstract.** The peculiarities of yield formation and grain quality of the new variety Tevkech in comparison with the Raushan variety in the Pre-Kama region of the Republic of Tatarstan on gray forest medium loamy soil with humus content of 3.35...3.52 % were studied. The work was carried out from 2019 to 2022 in the nursery of competitive variety trials. The analysis of the research has shown that under different conditions of cultivation, the variety is characterized by increased productivity, the average grain yield was 3.02 t/ha, more than the standard by 0.41 t/ha. According to the general adaptive capacity, it provides a high index (GASi – 0.31, the standard – 0.04). It is characterized by high values of the realization of the potential productivity (RPP – 69.7 %, the standard – 67.9 %) and the best genotype for breeding value (CCGi – 1.58, the standard 1.47), combining high productivity with a stable yield. Gross yield of protein per unit area averaged 378.32 kg/ha, 22.4 kg higher than the standard. In 2022 the variety Tevkech was included in the State Register of breeding achievements approved for use in the Middle Volga (7), Volga-Vyatka (4) and Ural (9) regions of the Russian Federation. Patent № 1162.

**Key words:** spring barley, variety, yield, protein, adaptability, stability.

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Original article

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## **EFFICIENCY OF PRE-SOWING SEED TREATMENT OF *VIGNA UNGUICULATA* SUBSP. *SESQUIPEDALIS*, *TRITICUM AESTIVUM* L. WITH SILICON OXIDE**

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**Abstract.** The lack of silicon in the plant body leads to its slow growth, development delay, therefore, studies on the effect of this element on plants are relevant. The purpose of the work is to study the effect of an aqueous solution of silicon oxide on the sowing qualities of plant seeds. The assessment of the effect of silicon oxide on the sowing qualities of seeds was carried out by the laboratory method according to MU 1.2.2635-10. Seeds of asparagus beans (*Vigna unguiculata* subsp. *sesquipedalis*) cv. Matilda and spring wheat (*Triticum aestivum* L.) cv. Svecha were used as indicators. The following indicators were taken into account: the energy of germination and germinating ability of seeds, the number, length and weight of the underground and aboveground parts of the seedlings. Statistical data processing was carried out by the dispersion method according to B. A. Dospekhov. The species-specific reaction of seeds to the treatment with silicon oxide was revealed. The best results in terms of morphometric parameters of seedlings of asparagus bean and spring wheat were obtained when seeds were treated with a 0.0025 % solution of silicon oxide. According to the research results, asparagus bean seeds turned out to be the most responsive to processing. The studied concentrations compared with the control (distilled water) contributed to a significant increase in the average length of the roots. At 0.01 % concentration, this indicator was higher by 30.6 mm, 0.005 % by 30.7 mm, at 0.0025 % by 48.8 mm, respectively ( $LSD_{05} = 30.1$ ). The average weight of the roots was more by 67.5 mg in the treatment of seeds with 0.0025 % solution of silicon oxide ( $LSD_{05} = 41.5$ ).

**Key words:** seeds; germination energy; germinating ability; asparagus bean; spring wheat; silicon oxide solution.

**For citation:** Lekontseva T. G., Fedorov A. V. Efficiency of pre-sowing seed treatment of *Vigna unguiculata* subsp. *sesquipedalis*, *Triticum aestivum* L. with silicon oxide. The Bulletin of Izhevsk State Agricultural Academy. 2022; 4 (72): 21-27. (In Russ.). [https://doi.org/10.48012/1817-5457\\_2022\\_4\\_21-27](https://doi.org/10.48012/1817-5457_2022_4_21-27).

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## STATE OF FRUIT AND BERRY PRODUCTION IN THE UDMURT REPUBLIC

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**Abstract.** The fruit and berry production averaged 25 kg per capita in the Russian Federation in 2020. This is significantly lower than the requirement defined by medical standards as 100 kg per capita per year. Therefore, the task was set to bring the level of self-sufficiency in fruit and berry production to at least 60 % in the Russian Federation. In solving this problem, we should count not only on the traditional zones of commercial fruit growing – the south and south-west of the Russian Federation, but also on other regions, including the Udmurt Republic, where natural and climatic conditions allow growing many berry crops and less fastidious varieties of fruit crops. The purpose of the study was to analyze the state of fruit and berry production and to evaluate its development. Using the methods of systematization, comparison and analysis of statistical data, it was revealed that at present only 13.2 kg of fruit and berry products per capita are produced in the Udmurt Republic, which is almost two times less than the average for Russia, and less than in neighboring regions. Households account for 95 % of the area of fruit and berry crops, and agricultural organizations – about 0 %. It is evidence that fruits and berries are cultivated primarily for personal consumption, and not for commercial purposes. The lack of real interest of agricultural organizations in the commercial production of fruit and berry products does not contribute to the use of modern planting material, the development of intensive technologies, an increase in yield and production of this biologically valuable product. As a result, the planting area of the main groups of fruit and berry crops in the Udmurt Republic does not increase but continues to decline.

**Key words:** fruit production, berry production, food security, import substitution.

**For citation:** Lentochkin A. M., Nikitina A. V. State of fruit and berry production in the Udmurt Republic. The Bulletin of Izhevsk State Agricultural Academy. 2022; 4 (72): 27-33. (In Russ.). [https://doi.org/10.48012/1817-5457\\_2022\\_4\\_27-33](https://doi.org/10.48012/1817-5457_2022_4_27-33).

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## BIOMETRIC INDICATORS AND YIELD OF BULB ONIONS DEPENDING ON THE PLANTING TIME OF ONION SETS

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**Abstract.** More than 200 varieties and more than 200 onion hybrids have been zoned in our country, but not all of them are well adapted to the conditions of Udmurtia. Therefore, it is necessary to search for the optimal planting time for sowing and selection of onion varieties to obtain high productivity under the climatic conditions of the Udmurt Republic. The purpose of the research is to study the effect of planting time of onion sets on the productivity of onion varieties. Analyzing these research results, comparison methods were used. In 2020 and 2022 studies were conducted on the cultivation of onion varieties at different planting time of onion sets under the conditions of the Mozhginsky district of the Udmurt Republic. The scheme of the experiment: factor A (variety): StuttgarterRiesen (St), Hercules; factor B (planting time): early spring, 5 days (control), 10 days from early spring. An agrochemical analysis of the soil was carried out before the trial establishment, weather conditions during the growing period were investigated, biometric indicators of bulbs and the productivity of bulb onions were studied. Studies have revealed that biometric indicators and the yield of onion varieties are closely related to the planting time and depend on the weather conditions of the growing season. The onion bulbs of the ShtuttgarterRizen significantly exceeded in the diameter of the bulb, the bulbs of the variety Hercules had the highest height, the variety Hercules outperformed in the bulb weight – 169 g. The maximum productivity on average for 2 years was obtained from the onion of the ShtuttgarterRizen variety – 2.66 kg/m<sup>2</sup> when planting onion sets in early spring.

**Key words:** bulb onion, variety, planting time, productivity, onion weight, the Udmurt Republic.

**For citation:** Tutova T. N., Ivanova T. E., Nesmelova L. A., Sokolova E. V., Andreeva Yu. O. Biometric indicators and yield of bulb onions depending on the planting time of onion sets // The Bulletin of Izhevsk State Agricultural Academy. 2022; 4(72): 33-40. (In Russ.). [https://doi.org/10.48012/1817-5457\\_2022\\_4\\_33-40](https://doi.org/10.48012/1817-5457_2022_4_33-40).

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## ANALYSIS OF WORLD PRODUCTION OF VEGETABLE CROPS

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**Abstract.** Vegetable growing is the most important branch of agriculture. It provides the population with such important food products as onions, tomatoes, carrots, cucumbers, cabbage, sweet peppers, table beets etc. The purpose of the research was to analyze the state of vegetable growing in the world, in the European continent, in Russia and in the Udmurt Republic. The results of research on the state of vegetable growing in the world, Russia and the Udmurt Republic are presented. The dynamics of acreage under vegetable crops, gross yields and yielding capacity of vegetables in all categories of farms are analyzed. The research has revealed that 1148.45 million tons of vegetable crops are grown in the world on an area of about 60 million hectares. The production of vegetable crops increases annually. 78.2 % of vegetables are grown in Asia, in Europe – 7.4 %, Russia accounts for only 1.2 % of world production. China is the largest producer of vegetables, Russia ranks 9<sup>th</sup> in the world. 30–35 vegetable crops are cultivated in the world. The most popular are tomatoes, cabbage, onions, cucumbers, eggplants, carrots, mushrooms, peppers and lettuce. They account for 60 % of world production. 84.58 million tons of vegetable crops were produced in Europe in 2020. Onions are in the first place among the vegetables grown in Europe, accounting for 10.4 million tons, cabbage is in second place – 9.62 million tons, carrots and turnips are in third place – 8.24 million tons. The largest producers of vegetable crops in Europe are Spain, Italy, and the Netherlands. 13.48 million tons of vegetables were produced in Russia in 2021. The largest areas are occupied by tomatoes, cabbage, onions, carrots and cucumbers. The average yield of vegetables in 2021 was 242 kg/ha. In 2021 in the Udmurt Republic vegetable crops were grown on the area of 3.5 thousand hectares. The main vegetable crops are cabbage, tomatoes, carrots, beets, cucumbers, onions.

**Key words:** vegetable growing, vegetable crops, open ground, acreage, gross harvest, yielding capacity.

**For citation:** Tutova T. N., Nesmelova L. A. Analysis of world production of vegetable crops. The Bulletin of Izhevsk State Agricultural Academy. 2022; 4(72): 41-49. (In Russ.). [https://doi.org/10.48012/1817-5457\\_2022\\_4\\_41-49](https://doi.org/10.48012/1817-5457_2022_4_41-49).

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Original article

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## DEVELOPMENT OF ENERGY-SAVING MEASURES FOR A SMALL GREENHOUSE

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**Abstract.** The article presents the results of an energy survey of a greenhouse farm owned by the FSBEI HE “RSAU – MTAA named after K. A. Timiryazev”. The main tasks of the research include: examination of the heat supply system of a greenhouse, determination of the actual state of its heat supply systems; thermal imaging survey; identification of excess heat energy losses; obtaining objective data on the amount of energy resources used; development of energy-saving measures for a greenhouse. As a result of the thermal imaging survey, heat leaks were detected through the heat-insulating structures of greenhouses, through worn-out and non-standard insulation of openly laid pipelines, etc. Calculations have shown that all this leads to an overpayment for thermal energy in the amount of 14,200 rubles/month for greenhouse № 1. It is proposed to use new pipes, to install a metering unit in the ITP, to use a digital system for automatic regulation of the parameters of the air environment and soil heating, to use a frequency electric drive to regulate the flow of liquid, and therefore the temperature of the coolant, to use a digital system for automatic regulation of heat.

**Key words:** energy-saving measures, digital system of automatic heat regulation, digital control system, automatic regulation of environmental parameters.

**For citation:** Bolshin R. G., Storchevoy V. F., Kondratyeva N. P., Krasnolutskaya M. G. Development of energy-saving measures for a small greenhouse. The Bulletin of Izhevsk State Agricultural Academy. 2022; 4 (72): 50-57. (In Russ.). [https://doi.org/10.48012/1817-5457\\_2022\\_4\\_50-57](https://doi.org/10.48012/1817-5457_2022_4_50-57).

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Original article

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## ON THE ISSUE OF ADHESIVE STRENGTH OF CERAMIC COATINGS WITH A STEEL SURFACE

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**Abstract.** Ceramic materials and functional coatings based on ceramic compounds have a number of advantages over standard structural metal alloys. They are characterized by high hardness and heat resistance, improved tribological properties and strength. The widespread use of ceramic materials is limited by their low manufacturability, the lack of effective technological processes of their obtaining. The problem of low manufacturability of ceramic materials is associated with the lack of effective adhesion of ceramic structures with metal surfaces, which limits the possibilities of their synthesis. Scientists of Udmurt State University and Udmurt State Agrarian University have developed a method for obtaining carbonitride coatings based on boron using high-speed laser fusion of powder materials. The resulting coatings are characterized by high adhesion strength to the steel surface. The aim of the work is to study the effectiveness of adhesion of ceramic coatings to a metal steel surface. To assess the adhesive properties, laboratory samples with a thin ceramic coating were obtained. Laboratory samples were subjected to wear tests and impact bending tests. Electron microscopy was performed to reveal the pattern of the fracture surface. The chemical composition of the coating and the adhesive zone was determined by X-ray spectroscopic method. The research results have shown that ceramic coatings have a dense and even structure, without visible cracks and chips. There are no pores, delamination and longitudinal cracks in the adhesive zone. Fatigue wear tests have shown high temperature resistance and resistance to jamming of friction surfaces. X-ray analysis of the adhesion zone revealed the presence of stable chemical compounds based on carbides and borides. The formation of chemical compounds is associated with the thermally reactive miscibility of the components of the ceramic coating with a metal base under the action of impulse high-temperature function of laser radiation.

**Key words:** ceramic coatings, adhesive strength, high-speed laser fusion, antifriction properties.

**For citation:** Ipatov A. G., Kharanzhevskiy E. V., Dorodov P. V., Smykov S. N., Malinin A. V. On the issue of adhesive strength of ceramic coatings with a steel surface. The Bulletin of Izhevsk State Agricultural Academy. 2022; 4 (72): 58-64. (In Russ.). [https://doi.org/10.48012/1817-5457\\_2022\\_4\\_58-64](https://doi.org/10.48012/1817-5457_2022_4_58-64).



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## MODERNIZATION OF A PLASMA-ARC FACILITY FOR CUTTING PIPES OF DIFFERENT SECTIONS

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**Abstract.** The use of plasma-arc cutting methods is an integral part of machinery production. Simplicity of design and cutting process provides high productivity and economic efficiency in the production of blanks and final products. Modern facilities for plasma-arc cutting have a wide range and capabilities for processing rolled metal of any size. The disadvantage of most plasma facilities is the difficulty of cutting materials with a complex section (rolled pipe). It is challenging to provide a constant length of the plasma jet during the cutting process, which is achieved by using special tracking systems. Additional installation of tracking systems on most plasma facilities is impossible due to design features and lack of software. In this work a plasma facility was upgraded to allow cutting shaped pipes. The plasma facility PLAZMA-15/30+prof was considered as a subject of the research. Modernization of the facility involves the installation of an independent additional module – a pipe cutter. The module is driven by a stepping electric motor of the plasmatron drive. Synchronization of the plasmatron and the kinematic modes of the pipe-cutting module is carried out by means of the Mach3 software package, designed for autonomous control of CNC machinery. To assess the possibility of cutting the section shaped material using an additional module, we investigated the quality of the cut line depending on the cutting speed. It follows from the research results that the use of a pipe cutter module makes it possible to manufacture final products and blanks from shaped pipes of various sizes. The performed studies allowed to determine the optimal cutting speeds using the pipe cutter module – from 1 to 1.5 m/min.

**Key words:** plasma-arc facility, modernization, cutting speed, pipe cutter module.

**For citation:** Pervushin V. F., Ipatov A. G., Smykov S. N., Shirobokov V. I. Modernization of a plasma-arc facility for cutting pipes of different sections. The Bulletin of Izhevsk State Agricultural Academy. 2022; 4 (72): 64-69. (In Russ.). [https://doi.org/10.48012/1817-5457\\_2022\\_4\\_64-69](https://doi.org/10.48012/1817-5457_2022_4_64-69).

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## **STUDY OF STRUCTURAL AND TECHNOLOGICAL PARAMETERS OF A VIBRATING CATCHER OF INORGANIC IMPURITIES**

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**Abstract.** The devices for separating impurity ingredients before crushing in grain crushers do not work efficiently and capture only metallomagnetic impurities. Previous studies have not established the dependence of the operation of the vibrating inorganic impurities catcher on the inclination angle of the bottom of the vibrating tray. The purpose of the work is to study the operating process of a vibrating impurity catcher. Tasks: laboratory studies of the dependence of the rate of immersion of impurities in grain and the dependence of the feed of the vibrating tray on its inclination angle. The studies were conducted using methods of a single-factor experiment in three replications. Wheat grains were taken as the starting material. For experimental studies, a laboratory installation of a vibrating screen was made with the possibility to adjust the angle of the bottom slope and to change the frequency, amplitude of the oscillation and with the possibility of registering the above parameters. The purpose of experimental studies was to determine the dependence of the rate of immersion of impurities  $V$  into the grain mass, as well as the throughput capacity of the vibrating screen  $Q$  at constant values of the amplitude and frequency of vibrations on the inclination angle  $\alpha$  of the bottom of the vibrating screen. The variation range of the bottom angle of the vibrating screen is  $\alpha = 0^\circ \dots 9.6^\circ$ . The experiments made it possible to find out that the rate of immersion of the impurity (gravel) increases to a value of  $V = 0.028$  m/s with an increase in the angle of inclination to a value of  $\alpha = 7^\circ$ , and then remains unchanged. The initial throughput capacity of the vibrating screen at an angle of inclination  $\alpha = 0.2^\circ$  is  $Q = 0.026$  kg/s, which increases linearly depending on the increase in the inclination angle of the bottom of the vibrating screen.

**Key words:** grain, crushing, impurities, vibrating tray, feed, speed, efficiency.

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