

Original article

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PROMISING VARIETIES OF GRAIN AND LEGUMINOUS CROPS FOR CULTIVATION IN UDMURTIA

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Abstract. The information on varietal zoning is necessary to improve the efficiency of cultivation of a particular crop. The purpose of the study was to identify promising varieties of grain and leguminous crops for cultivation in the Udmurt Republic. To achieve the goal, the following tasks were set: to analyze the State Register of Selection Achievements and identify varieties approved for cultivation in the Volga-Vyatka region over the past 5 years (2018–2022); to give a comparative assessment of individual varieties of field crops in field and laboratory experiments. Theoretical methods (analysis of State Register data, generalization) and empirical methods (field experience, laboratory analysis, statistical analysis of experimental data) were used in the work. Field studies were conducted in the educational scientific and industrial complex “Agro-Technopark”, laboratory studies – at the Department of Plant Cultivation, Crop Farming and Selection of Udmurt State Agricultural University according to generally accepted methods; in the Department of Analytical Research of the Tatar Research Institute of Agriculture – Subdivision of FRC “Kazan Scientific Center of Russian Academy of Sciences” – on the grain analyzer FOSS NIRS DS 2500 F. More than 80 varieties of the main grain and leguminous crops of domestic selection have been included in the State Register in the Volga-Vyatka region over the past 5 years. The conditions of the Udmurt Republic provide an opportunity to realize the potential of varieties in accordance with the principles of their selection. Along with the traditional crops the less widespread ones deserve attention. The minor crops also have varieties approved for the use in the Volga-Vyatka region. According to the research data of the Udmurt State Agricultural University, the winter hardiness (3.6 points) and grain yield (5.66 t/ha) of winter triticale varieties exceed the these indicators of winter wheat varieties (2.2 points and 3.10 t/ha, respectively). Biological features of spring triticale varieties provide an opportunity to obtain grain yield of 683 g/m², which is 14 % higher than the yield of spring wheat varieties. The advantage in yielding ability of the domestic variety of field pea Usatyi was 39–47 % over foreign varieties.

Key words: variety, State Register, winter rye, winter and spring wheat, winter and spring triticale, barley, oats, peas, blue lupine.

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Original article

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INFLUENCE OF VITAMIN AND MINERAL FEED SUPPLEMENTS ON THE PRODUCTIVITY OF HONEY BEES (APIS MELLIFERA)

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Abstract. The use of modern technologies provides an opportunity to obtain stimulating drugs of a new generation. The aim of the study was to evaluate the productivity of honey bees when using a feed additive taking into account the compatibility of vitamins and mineral components. The research was carried out on honey bees according to traditional methods approved by the Research Institute of Beekeeping. Four experimental groups with 10 bee families in each group were selected in a stationary apiary (Udmurt Republic, Zavyalovsky district) in the spring-summer period of 2022. When forming groups we took into account the strength of families, the number of brood, the age of the queen bee and the design of the hive. Feeding was carried out after the bees wintering in the second half of April. The first group of bees received a vitamin and mineral supplement prepared according to the generally accepted scheme. The second and third groups received a vitamin and mineral supplement consisting of chelated compounds, but the third group received a higher dosage. The fourth group was control. According to the research results, the gross and commercial honey productivity in the third experimental group exceeded the indicators of the control group by 19.1 % and 32.2 %, respectively. The maximum amount of brood on the 36th day after fertilizing was recorded in the third experimental group, which was up by 24.75 % than in the control group (191.5 hundred cells), in the second experimental group – by 20.5 % (31.5 hundred cells). On the 36th day of the study the indicators of oviparity of queens in the third experimental group were higher by 24.7 % than in the control group.

Key words: beekeeping, honey productivity, feed additive, chelated compound, mineral components, vitamins.

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AGROECOLOGICAL ASSESSMENT OF VARIEGATED ALFALFA VARIETIES IN THE CONDITIONS OF NORTHERN KAZAKHSTAN

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Abstract. When cultivating field crops, the variability of quantitative features is determined by the growing conditions and the interaction of “genotype × external environment”. Varieties should be tolerant to biotic and abiotic factors of growing conditions, high-tech, that is, an adaptive variety is not only an ecologically plastic variety, but also adapted to optimal conditions and to the signs of minimum and maximum values of external factors. The aim of the research is to study the adaptive properties of alfalfa varieties in the conditions of Northern Kazakhstan and to identify the most adapted ones to the conditions of the region. The research was carried out on the basis of stationary field experiments in the Scientific and Production Center of Grain Farming named after A. I. Barayev of the Republic of Kazakhstan. The soil and climatic conditions of the research site are typical for the dry-steppe zone of the southern part of Northern Kazakhstan. The soil of the experimental site is low-humus southern carbonate chernozem, which is characterized by a high content of carbonates. 32 variegated alfalfa varieties of different ecological and geographical origin were studied, including 10 varieties of Kazakhstan selection, 18 varieties of Russian selection, 3 varieties of Canadian selection and 1 variety of Ukrainian selection. During four years of research the varieties of the Kazakhstan selection Kokshe, Karabalykskaya 18 and the variety of the Russian selection Chishminskaya 131 had high adaptability forming a yield of green mass of 22.2–23.3 t/ha. Varieties of Russian selection Guzel, Tatar pasture, Uralochka, Nakhodka, varieties of Canadian selection Ferax, Rangelander, Rhizoma, varieties of Kazakhstan selection Karabalykskaya raduga, Karagandinskaya 1 (20.0–21.5 t/ha) were not inferior to the standard (19.7 t/ha) in productivity. Varieties Shortandinskaya 2 and Flora 7 were characterized by weak responsiveness to changes in abiotic conditions, the coefficient of ecological plasticity in these varieties is the lowest ($bi = 0.06–0.11$).

Key words: variegated alfalfa, varieties, adaptability, ecological plasticity, productivity.

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QUALITY AND TECHNOLOGICAL PROPERTIES OF MILK OF COWS OF DIFFERENT LINES

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Abstract. Milk productivity and technological properties of milk are greatly influenced by the genetic potential of cows, which is largely determined by the servicing bulls used for the herd production. This paper studies the dependence of dairy productivity and milk quality of Black-and-White cows on their origin in the «Izhagroplem» UdSAU. Data from breeding records of the SELEX program were used for studying the genetic potential of dairy productivity of breeding bulls used on the farm and the productivity of their daughters. To study the quality and technological properties of milk three groups of cows of different origin were formed: cows of the Reflection Sovering line, Vis Back Ideal line and Montvik Chieftain line. The best indicators were found in the milk of cows from breeding bulls of the Reflection Sovering line. The bulls of this line can be improvers in terms of fat, protein and MSNF content in milk. The smallest number of somatic cells in milk was found in cows of the Vis Back Ideal line. The milk of cows of all lines in the farm has a low protein content – 2.93–2.95 % and a high fat content – 4.27–4.67 %. For improving the technological properties of milk in the farm it is necessary to increase the protein milk producing ability of cows. In order to achieve this purpose for the further reproduction of the herd, we recommend to use more widely such breeding bulls as Diller 2384 (Montvik Chieftain line), Escart-M 3372303615 (Reflection Sovering), Manat 1084 (Reflection Co-vering) and Alta Pilsner 70344827 (Vis Back Ideal), since the daughters of these bulls have higher protein content in milk compared to herd mates. The milk produced in the «Izhagroplem» UdSAU has high thermal stability, therefore it is advisable to use it in the food production with high-temperature processing.

Key words: milk productivity, Reflection Sovering line, Vis Beck Ideal line, Montvik Chieftain line, mass fraction of protein, cheese production suitability, cottage cheese yield, thermal stability, yoghurt production suitability.

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INCREASING THE WEAR RESISTANCE OF PLOUGH SHARES, CULTIVATOR SHARES AND SWEEPS BY SPOT ARC WELDING

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Abstract. The demand for plough shares in neighboring countries and Russia ranges from 25 to 35 million pieces per year. Under these conditions it is advisable to restore the life of the plough share by applying a wear-resistant layer on the back side providing self-sharpening of the blade, pre-hardening of the blade of the plough share and the share nose on newly manufactured ones, followed by their welding to a part of the plough share. The aim of the work was to study the hardness of experimental samples deposited with various electrodes to increase the wear resistance of the plough share by spot deposit welding; to develop recommendations for the implementation of plough share surfacing technology in the maintenance and servicing bases of various levels. The T-590, CL-11, MR-3C electrodes were used in the research. The surfacing was carried out at a direct current of reverse polarity $I_{cb} = 100...160$ A, $U_{cb} = 25...30$ V, rolled steel was used as the surfaced base, its geometric parameters correspond to the geometry of the cutting blade of the plough share. Four welding points with an interval of 30...40 mm were deposited with each electrode type. The analysis of the regularities of the hardness distribution over the depth of the welding points shows that the hardness remains almost unchanged over the entire height of the welding point, regardless of the classification of electrode used in the process of surfacing. The maximum hardness (on average 55...58 HRC) is achieved by using a T-590 electrode. The use of the proposed restoration technology increases the wear resistance of plough shares, and the obtaining of the optimal geometry of the cutting edge reduces the pulling force of the transporting unit and contributes to better soil treatment.

Key words: analysis, wear, plough share, technology, electrode, construction, wear resistance, hardening.

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INVESTIGATION OF TRIBOTECHNICAL PROPERTIES OF METAL MATRIX COMPOSITES WITH A NICKEL MATRIX AND SUPER-HARD CERAMIC INCLUSIONS

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Abstract. The use of thin functional ceramic coatings is limited due to technological reasons and the lack of complete information about their tribological properties. The Department of Operation and Maintenance of Machines has experience in testing and operating of thin ceramic coatings based on boron carbide. The specific features of the adhesive interaction between ceramic materials and traditional antifriction alloys do not allow their use in most mechanical engineering units. This paper considers the features of the tribological behavior of nickel-based metal-matrix composites additionally strengthened with zirconium dioxide ZrO_2 . The technology of high-energy short-pulse laser melting of fine powder compositions was used to obtain laboratory samples. To evaluate the tribological properties, metal-matrix composites with different contents of zirconium dioxide ZrO_2 were obtained. The wear tests were carried out according to the standard method with the “Disk-Pad” loading scheme under boundary friction conditions. Friction coefficient and temperature in the friction zone were studied as control tribological parameters. The conducted studies have shown the dependence of the friction coefficient and temperature on the content of zirconium dioxide. The introduction of zirconium dioxide stabilizes the wear rate and reduces the friction coefficient to 0.03, while increasing the scratch resistance and heat resistance of the coating, which has a positive effect on the resource of conjugation. The decrease in the friction coefficient and temperature in the friction zone is caused by the formation of a tribolayer based on a mechanical mixture of oxide compounds with non-oxidized coating components, caused by the selective transfer of substance. An increase in temperature in the friction zone stabilizes the tribolayer since the intensity of oxidation of the coating components increases.

Key words: ceramic coatings, tribolayer, coefficient of friction, metal matrix composite.

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Original article

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STUDY OF THE OPERABILITY OF HARDENED VALVES OF ICE

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Abstract. The use of gas fuel negatively affects the details of the gas distribution system of the internal combustion engine (ICE), especially the coupling “valve seat – valve”. The working surface of the valve is modified with special heat-resistant coatings based on the use of metal matrix connections for protection against high temperatures. But the physical and mechanical properties of the coatings used do not fully correspond to the operating conditions of gas engines which leads to their premature failure. The purpose of this work was to study the operability of valves with a ceramic hardening coating obtained by the method of short-pulse laser treatment, implemented specifically for gas-fueled internal combustion engines. The methodology has been developed and the stand for accelerated testing of valves for heat resistance has been designed on the basis of a stand for lapping OPR-1841A valves for operability analysis. The hardened exhaust valves of the KaMAZ-740 engine were analyzed as an object of research. Comparative tests were carried out with a standard heat-resistant coating of the VK3 type for assessment of ceramic coatings operability. The operability of the ceramic coating was evaluated by the dynamics of the change in the width of the working belt of the valve chamfer under the influence of dynamic and thermal loading. The analyzed valve with a ceramic hardened coating formed a working chamfer with a width of 0.75 mm at the first stage of thermal cycling. At the second stage of thermal cycling the width of the working belt reached a width of 1.1 mm and no further increase and wear of the chamfer was observed. The research results confirmed the high wear resistance and heat resistance of the analyzed coatings. The approximation of the research results revealed a decrease in the wear intensity of the working chamfer by 480 % in comparison with the standard coating VK3.

Key words: protective coating, valve face, surface modification, wear, valve mechanism.

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THE EFFECTIVENESS OF THE ALL-PURPOSE MULTIFUNCTIONAL MODULAR COMPLEX “TUMAN” DURING WINTER WHEAT CULTIVATION IN “PEGAS-AGRO”

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Abstract. Agrochemical work in agriculture with the obligatory use of fertilizers is the basis for the efficient production of products by the agro–industrial complex of the Russian Federation. The purpose of the research work of the Samara State Agrarian University together with the largest chemical concern in Russia “KuibyshevAzot” and the Samara enterprise “Pegas-Agro” is to improve agricultural technologies of cultivating crops for increasing their yield and grain quality. The subject of research is mineral fertilizers – liquid nitrogen based on a carbamide-ammonia mixture (CAM), and technical means – sprayers and multi-injectors “Tuman” for applying liquid fertilizers on the surface and subsurface of soil. Fertilizers based on CAM-32 and a tank mixture of CAM + S + potassium humate + trace elements Cu + Zn + Br + inhibitor were studied under different weather conditions: 2021 – dry year, 2022 – year with favorable weather. The experiments compared an innovative unit for injecting liquid fertilizers by a multi-injector “Tuman-2M” with a rod sprayer “Tuman-2” produced by “Pegas-Agro”. The research results have established that fertilizers with different nitrogen content norms introduced by injection, compared with the surface distribution, provide an additional increase in the yield of winter wheat (the variety Basis of selection of the Samara Research Institute of Agriculture participated in the experiments), especially during droughts (2021). The application of CAM + S at the rate of application by a multi-injector of 200 l/ha in experiments increased yield to 56.1 c/ha compared to 48.4 c/ha obtained while using the sprayer (+15.7 %). With sufficient moisture supply (2022) liquid and solid fertilizers are almost equivalent. The multi-injector in comparison with the sprayer when applying liquid fertilizers CAM in large doses (300, 350 l/ha) provides an increase in yield from 71.5 c/ha (2021) to 78.5 c/ha (2022), which is significant for risky farming of the Volga region. Grain quality is also improved to Grade II and I after using liquid nitrogen fertilizers.

Key words: technologies, agricultural products, agrochemistry, winter wheat, yield, liquid fertilizers, carbamide-ammonia mixture (CAM), multi-injector, sprayer, efficiency.

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Original article

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JUSTIFICATION OF THE METHOD AND DEVICE FOR INTER-ROW CULTIVATION OF POTATOES

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Abstract. The dynamic (rotational) tools of agricultural machines completely meet the agro-technical requirements for the handling of potatoes. The purpose of the study is to substantiate the parameters and operating modes of the rotary ripper to increase the efficiency of soil loosening and weed destruction during the inter-row cultivation of potato plantings. Theoretical studies of the process of interaction of the rotary working element with the soil were carried out. The design of the rotary ripper is presented and the motion trajectory of its working elements is described. The amount of dragging of the upper layer of soil by the scraper-bar of the rotary ripper in the contact zone with the soil is established. The section of the path from the beginning to the end of the dragging of the surface layer of soil, on the line of which the destruction of the soil crust and weeds occurs, is analyzed. The graphical dependence of the working stroke of the scraper-bar on its kinematic mode of operation is presented. To increase the efficiency of soil loosening and destroying weeds with a rotary ripper, the most effective is the option with the points located on the medium and small ripper discs making a shortened (elongated) cycloid. At the same time, the scrapers of the rotary ripper drag the surface layer of soil forward, destroying the soil crust, loosening it and destroying weeds in the phase of the white thread, and also uproot and drag the sprouted weeds forward. With a decrease in the radius of rotation of the working elements of the rotary ripper from the large disc of the harrow in the direction of the smaller one, the length of the working stroke and the amount of dragging of the topsoil increases. It corresponds to 289.3 mm for a small disk with a kinematic operating mode indicator $\lambda = 0.5$.

Key words: cultivator, weeds, rotary ripper, scraper-bar, harrow, soil, surface, technology.

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