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MODIFYING THE TECHNOLOGICAL PROCESS OF A HAULM TOPPER TO IMPROVE THE QUALITY OF TABLE POTATO*ANDREI B. KALININ, DSc (Eng)¹*

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The paper contains the results of evaluating the quality indicators of marketable potato using a criterion of greening degree of the tuber surface. The authors have revealed the reasons for the decrease in potato commodity features and proposed technical means for compacting the ridges simultaneously applying the method of haulm topping. The statistical data obtained as a result of years of field experiments on the farms of "Detskoselsky" concern in the Leningrad region have shown that the coefficient showing the ratio of the total area of longitudinal cracks on the comb surface to the middle row area corrected by the linear meter of a row and expressed in percentage varies in the range of 1.82 to 4.67%. The specific amount of green tubers harvested from experimental plots and subject to rejection varies from 2.18 to 3.78 percent. Depending on the soil type and technological methods of potato cultivation used on the farms, at an average potato yield of 30 t/ha, losses from greened tubers range from 654 to 1041 kg/ha. It has been determined that ridge rolling made by active rollers with hydraulic drive allows to remove cracks on the top of ridges and prevent the daylight from affecting tubers located close to the soil surface. Experimental studies have allowed to determine the rational operation modes of an active roller, under which the hardening of the ridge surface is observed, and which ensure the safety of ridges against adverse weather conditions over a long period of time.

Key words: characteristics of marketable potato, planting of tubers, haulm shredder, active roller, rolling ridges, potato preparation to mechanical harvesting.

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EFFECTS OF WATER ABSORPTION ON POTATO YIELD AND MOISTURE CONTENT IN SOIL*OKSANA A. STAROVOITOVA, PhD (Ag)*

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The paper considers the application of water absorbents in potato growing as an effective means of moisture conservation under the conditions of the climate change. To assess local application of water absorbents when potato planting the author has conducted field and laboratory studies of their action on water-retaining capacity of sod-podzolic sandy loam soil. According to the results of field tests, the varieties of Zhukovsky early, Udacha and Nevsky have increased yields from 25.9...29.9 to 31.6...36.9 t/ha when introducing biopolymers (hydrogels). After comparing different types of water absorbent materials, it has been established that applying biopolymers (hydrogels) at a rate of 2 g/bush (100 kg/ha) on average has increased the potato yield by 9%, exfoliated vermiculite at a rate of 0.1 l/bush (5000 l/ha) – by 10%; bio containers with peat, biocompost and micronutrients and water absorbent perlite – by 24%. Hydrogel and vermiculite may be introduced into soil along with granular fertilizers, bio containers, together with planting tubers. It has been found that 2 g of hydrogel in soil is capable of holding up to 86.7 cm³ of water, while 100 ml of vermiculite – 70 cm³ of water, and one biocontainer with perlite – 85 cm³ of water. Control samples managed to maintain optimal soil moisture for potato growth over a period of 5 days, samples with biocontainers – 10 days; those with vermiculite – 12 days, and those with hydrogel – 16 days. Thus the feasibility of applying water absorbents as an effective means of moisture saving in potato growing has been experimentally approved.

Key words: soil, humidity, hydrogel, vermiculite, bio container, perlite, potato yield.

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DESIGNING A DRIP TAPE LAYER ON THE BASE OF ROTARY HILLER GRIMME GF 75/4 FOR POTATO GROWING

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The authors have approved the feasibility of using drip irrigation to provide for an optimal water and air balance during the whole vegetation period. They have experimentally determined a geometric shape of the humidification contour, which is a parabola of the fourth power. Having determined the optimal parameters of the humidification contour, they have calculated the required flow of irrigation water and medicated theurapical agents to be delivered directly to the root zone. To check the obtained theoretical dependencies, parameters of the humidification contour of the dropper with a flow rate of 2 l/h have been determined in the laboratory ground tray. The dropper has operated for 3-30 minutes. The shape of the humidification contour has confirmed the data of theoretical studies. The authors suggest an optimum timeframe for stacking a drop tape and present a developed system of drip irrigation for potato cultivation. The design of a unit for laying the drop tape has been developed as well. The unit has been tested (in parallel with its combing operation) at the Field Experimental Station of the Russian State Agrarian University. Rotary hiller Grimme GF 75/4 as been equipped with working elements for laying the drip strip in the crest into a depth of 20 mm. The drip strip has been laid, drip irrigation and delivery of insecticidal and fungicidal preparations to the root zone of plants have been carried out. It has been established that the laying of the dropping tape is more expedient to be carried out in parallel with combing for 7-10 days from the beginning of planting, as this will reduce the machine operation time and labor costs. Using drip irrigation, it is possible to deliver medicated theurapical agents directly to the potato root zone, which will increase their therapeutic effect and reduce the medicated material consumption.

Key words: humidification contour, drip irrigation, sprinkler irrigation, water consumption, root zone, flow rate.

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IMPROVING THE DESIGN OF A COMBING DEVICE FOR HARVESTING LEGUMINOUS CROPS

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The paper focuses on one of the main goals of the cultivation of leguminous crops – obtaining high-protein food, feed or technical raw materials. The Lupine albus is represented as a crop included into the State Register of selection achievements permitted for use on the territory of the Russian Federation. The authors consider an unconventional technology for harvesting leguminous crops using the combing method, which will reduce energy costs, damage rate and seed loss. It has been determined that the main source of damage in combing devices is a combing drum rotating at a high speed and interacting directly with the seeds of crops being harvested. Their geometric parameters exert a paramount influence on the harvesting quality. The design features of the existing work tools do not fully ensure the minimum possible loss and damage when harvesting Lupine albus. The authors have made a patent-technical analysis of the existing combing working elements for harvesting large-seed crops registered in the Patent database of the Federal Institute of Industrial Property (Rospatent) and the “Espacenet” Patent base. After analyzing the designs of combing devices for large-seed crops, the authors have proposed a combined working unit, which allows reducing the damage of Lupine albus grain. When mounted on the drum of the combing head for harvesting Lupine albus together with combs for harvesting large-seed crops, this unit allows reducing damage and loss of seeds.

Key words: combing device, Lupine albus, harvesting, combine harvester, harvesting technology.

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JET MODEL OF VENTILATION AIR INFLOW FROM HEAT-RECOVERY UNIT

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The paper considers a jet model of the ventilation air inflow from a heat recovery unit. The authors proceed from an assumption that the inflow and exhaust of ventilation air is produced mechanically with axial fans; supply air enters the room directly from the fan without nozzles and air ducts, which forms a suction plume and a supply jet. Taking into account Archimede's buoyant force and general laws of jet streams, the authors have designed a model of indoor air distribution, which makes it possible to determine axial velocity of the jet at a distance from the outlet and estimate the trajectory of the jet propagation. The adequacy of the design model has been tested experimentally in the fattening section of a pig farm of LLC "Mortadel". In the considered case, the inflow air featured a temperature lower than the indoor one, which led to a deviation of the jet trajectory in the direction of gravity. The adequacy, reliability and accuracy of the model comply with the accuracy required for practical calculations. The paper provides graphical dependencies of the jet velocity and the distance from the outlet. The obtained model allows calculating the trajectory of the jet motion, which enables us to implement the flow vector correction algorithm to ensure the required range in current weather conditions. It has been established that the discrepancy between theoretical and experimental data does not exceed 12.9%. The accuracy of the results depends to a large extent on the empirical coefficients that determine the velocity change rate and the temperature difference in the jet. In the future, it is planned to study the profiles of the suction plume and the supply jets in longitudinal and cross sections.

Key words: ventilation, microclimate, heating, heat recovery, hog breeding, microclimate system, jet streams, heat utilization.

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EFFICIENCY OF AGRICULTURAL MACHINERY MODERNIZATION BY MEANS OF MODULAR TRANSPORT

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The paper some issues of modernization and application of the modular construction technology applied to ensure the efficiency of agricultural operations at minimal labor and material costs. The authors present functionality enhancement solutions implemented through the modular design and the application of the universal wheeled chassis. It is emphasized that the universal wheeled chassis as a comprehensive base for all possible engineering options is of considerable scientific interest, as well as wide practical application. The authors stress that having the considered chassis and a set of modules on the farm will enable farmers to stop using highly specialized sprayers. The paper outlines the characteristics of farm machines "Tuman-1" and "Tuman-2" of the "Pegas-Agro" company specializing in a wide range of fertilizer application. The paper presents the advantages of the of "Tuman-1" and "Tuman-2" design solutions: quick pay-back, low-volume pollination, fast filling system; high mobility not requiring a free tractor, a simple and reliable design. According to the tests conducted by the Povolzhiye Machine Testing Station, the "Tuman-1" spreader reliably performs the technological process in all main agrotechnical indicators. During the test period of 85 hours, no failures have been detected. The availability factor is 1.0. It is noted that "Tuman-1" is recommended for serial production and including into the Federal System of Mashines. The authors prove the expediency of using modular transport in plant growing as an effective way of modernizing agricultural machinery, which allows to reduce costs while maintaining the quality of products and ensuring an increase in crop yields.

Key words: modular transport; universal chassis.

TECHNICAL SERVICE IN AGRICULTURE

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STUDY OF IMPACT REGULARITIES OF NON-ENGAGING BARS ON WORKPIECE SURFACE

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The paper aims at studying the effects of abrasive grains of honing bars on the surface of workpieces. Basing on the probability distribution of abrasive grains by volume of the tool's cutting layer and the process kinematics the authors have calculated the height distribution pattern of a part's asperities. This distribution helps determining both roughness

parameters of a part's surface, and cutting process features – the area of cuts, the number of contact grains, etc. The paper provides a comparison of discrete and continuous tool models and their mathematical ratio. A discrete model more realistically reflects the abrasive tool structure, however there are no convenient methods for measuring it. The authors present an established mathematical ratio between the distribution of abrasive grains according to the height and the depth distribution of scratches produced by the tool on a polished sample. Basing on the obtained information on the discrete model of diamond bars, the authors have calculated geometric parameters of their cutting surface. The comparison of the calculated and experimentally found values of the bar parameters confirms the accuracy of the proposed method. It has been shown that both discrete and continuous mathematical models of the abrasive honing tool bring identical results. The authors have obtained general analytical expressions to calculate the roughness parameters of a part's surface, the metal removal rate, cutting forces, cut areas, the number of contact grains, etc. Inserting the characteristics of bars in the formulas, one can calculate all microgeometry parameters of a part.

Key words: honing, improving reliability, cutting process, mathematical analysis, discrete model, continuous model.

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DETERMINANTS OF QUALITY CONTROL ACCURACY OF AUTOMATED MEASURING DEVICE FOR SPARE PARTS OF AGRICULTURAL MACHINERY

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The paper is devoted to the improvement of methods and means of ling physicomachanical and geometrical parameters of spare parts at technical service enterprises. As an experimental installation, an automated measuring device has been developed to control physical-and-mechanical and geometric parameters of spare parts. The author has determined the most significant factors influencing the control accuracy of automated devices: light radiation intensity, the distance from the radiation source to the monitored spare part, the external environment temperature. Basing on the study results of the effect of these factors, it has been determined that the optimum value of the distance between the measuring instrument (the Riftek RF 620 laser scanner) and the monitored object should be equal to 115...135 mm, the probability of measurement error being less than 5%. Basing on the study results, the author has stated that the optimal value of the distance between the measuring tool and the monitored object is the first 34% of the working range of a triangulation laser scanner, the optimum power of a scanner is 1.5 mW, the temperature mode of the device ranging from $-10^{\circ}\text{C}...+40^{\circ}\text{C}$. Spare parts (shafts, gears, axle shafts) of the front driving axle of the MTZ 82 tractor have been examined by means of an automated measuring device. The checking results of the parameters of spare parts have revealed that 10% of the gear parts do not correspond to the diameter required for a roller bearing, 7.5% of shafts and 15% of axle-shfts and gears do not correspond to the required mass value, which indicates a mismatch between physical and mechanical properties of the material. Thus the expediency of using an automated measuring device has been experimentally confirmed, which allows controlling the quality of spare parts.

Key words: quality control, noncontact measuring means, automated measuring device, technical service.

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OPERABILITY OF “SHAFT-CUP” COUPLINGS AND THEIR RELIABILITY ENHANCEMENT

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The paper analyzes the influence of operating conditions of agricultural machinery on the performance of bearing units. The author lists main reasons for low reliability and durability of cup-type seals of agricultural machines: progressive deterioration (deterioration) of the physical and mechanical properties of cups, lower antifriction properties of materials, the presence of abrasive particles in grease and on the working surface of cups. Then he suggests some ways of reducing the shaft wear and the friction coefficient in the coupling. The ways of increasing the efficiency of the “shaft-cup” coupling are studied, in particular: the treatment of working surfaces with epilating compounds (EC); finishing antifriction non-abrasive treatment (FANAT); surface treatment with organ fluorine compounds (OFC). As a result of the experiment, it has been established that coatings made of antifriction materials reduce the friction coefficient and increase the wear resistance of working surfaces, the use of EC and OFC has also contributed to decelerated aging of rubber components. The epilamation of the working surfaces of shafts and cups provides for increased wear resistance of couplings of 1.2 times and more. This method is especially effective for newly produced couplings and machinery couplings intended for storage. Surface treatment of OPC can be effective for both new couplings and for the restoration of the worn out ones. Combined treatment methods using FANAT are more time-consuming and expensive.

Key words: agricultural machinery, bearing units, cup-type seals, reliability, wear resistance.

ECONOMY AND ORGANIZATION OF AGRICULTURAL ENGINEERING SYSTEMS

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DETERMINING TECHNICAL EFFICIENCY OF MANAGEMENT SYSTEM IN AGRIBUSINESS (AS EXEMPLIFIED BY MONGOLIAN HORSE-BREEDING)

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The paper considers a possibility of increasing the efficiency of agricultural production by optimizing the parameters of economic activity and using internal reserves of agricultural enterprises. This methodology based on the theory of V. Pareto has been tested using the case study for 2013-2015 in the Battsangal summon of the Arkhangai aimag of Mongolia among 123 farms engaged in horse-breeding. Basing on the indicators of income amount and production costs, the authors have estimated the efficiency. The efficiency model has been made using the standard program DEAP 2.0. According to the assessment of technical efficiency focused on minimizing resource costs with variable effect of economy of scale, it has been assumed that 60.2% of farms can improve their performance by reducing input costs. Basing on the calculation results of technical efficiency aimed at maximizing output, the share of "reference" farms with a variable scale effect has accounted for 19.5%. Studies have shown that 80.5% of farms can improve their performance by increasing the amount of gross revenue at the same amount of input costs. It has been established that livestock farms in Mongolia possess significant reserves to improve the efficiency of their operations by optimizing the technical parameters of economic activity. It can be concluded that the use of mechanization tools for labor-intensive processes will significantly increase production and improve the efficiency of horse-breeding.

Key words: technical efficiency, horse breeding efficiency, optimization of economic activity parameters, Mongolia.

POWER SUPPLY AND AUTOMATION OF AGRICULTURAL PRODUCTION

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SIMPLE SOURCE OF "GREEN" ENERGY

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The paper reports the results of an experiment carried out on a small scale using a bio-photoelectric element (HPV element) of "green energy" in which cyanobacteria act as electron generators. Green moss as an object using photosynthesis was placed in a container over an electrode system. The cathode was represented by a metal container. The anode was made from a thin copper wire with a diameter of 0.4 mm coiled into a fl at spiral. The tank was filled with ordinary water, and the electrode terminals immediately showed a potential difference, which in some cases reached 0.5Volts. Thus, using green moss and its ability to actively participate in photosynthesis with the help of cyanobacteria, it has become possible to reproduce the experiment on obtaining "green" energy. As a result of the experiment, it has been established that the resistance values of the BPV element in opposite directions differ, sometimes this difference is quite significant. This is a result of the BPV element's similarity to the diode. It has also been established that the BPV-element is able to "remember" and for some time "keep" the potential of an external source of the EMF. So, if a short-time external voltage of several volts is applied to the BPV element, regardless of the polarity, after switching off the EMF, the BPV element behaves like a capacitor, i.e. the voltage at its terminals gradually decreases to the initial value. Thus, a possibility of obtaining electric energy on the basis of cheap and simple means has been confirmed, which is very important for areas with a lack of centralized power supply.

Key words: alternative energy, moss, photosynthesis, cyanobacteria, symbiosis, electric current.

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DEVICE FOR DETERMINING HUMUS CONTENT IN SOIL

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The authors report on a newly developed device for express control of humus content in soils, which makes it possible to carry out their analysis at minimum costs. The electrical resistance of soils has been studied as an objective and easily determined diagnostic indicator of agroecological assessment of soil properties. The developed instrument contains the nodes for amplification and conversion of the signal coming from the measuring electrodes, and the nodes forming the probing signal of a constant or alternating current of a given magnitude. The path of conversion and amplification of the signal coming from the measuring electrodes includes an input filter, an input amplifier, a low-frequency generator, an amplitude detector, and an analog-to-digital converter with a display. The principle of measuring the electrical resistance of soil is based on the use of a multi-electrode sensor. At the same time, a probing voltage of direct or alternating current (0.1, 1.0 and 10 mA and frequency 1, 10 or 100 kHz) is applied to the electrodes, and a signal proportional to the electric resistance of soil (between the electrodes) is removed from the measuring electrodes. A significant advantage of this device is the reduction of the measurement error due to the use of an alternating current as a probing signal, the specific electrical resistance being calculated per unit area [$\text{Ohm}\cdot\text{m}^2$], instead of unit length.

Key words: humus, soil, measurement, electrical conductivity, analog-to-digital converter, probing and measuring electrodes.