

AGRONOMY, FORESTRY AND WATER MANAGEMENT

General Farming and Crop Production

UDK 633.15:631.8(470.64)

Efficiency of using fertilizers for corn in the foothill and steppe zones of Kabardino-Balkaria

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Abstract. The article discusses the use of mineral fertilizers when growing corn in the foothill and steppe zones of Kabardino-Balkaria. The purpose of the study is to study the effect of different doses of mineral fertilizers on the productivity of corn hybrids. Field experiments were conducted in 2021-2023. The experimental plot in the foothill zone (village Chegem-2) is characterized by the following agrochemical indicators: humus content in the arable horizon – 3.3%, total nitrogen – 0.28%, absorption capacity – 34.4 mg·equivalent per 100 grams soil, the reaction of the soil solution is neutral (pH – 7). The content of mobile phosphorus is 15.0 mg per 100 g of soil, that is, the average supply (according to Chirikov), the supply of exchangeable potassium is increased – 15-18 mg per 100 g of soil (according to Chirikov). The mechanical composition of this soil is heavy loamy. The content of physical clay in it is 57%. Field experiments were also carried out in the steppe zone (Verkhny Kurp village). The soil of the experimental plot is ordinary (carbonate) chernozem of heavy loamy mechanical composition with the following content: humus – 3.0-3.5; P₂O₅ – 0.14-0.27 and K₂O – 2.0-2.6% (according to Machigin). Based on the results obtained, taking into account modern market relations, it is possible to recommend that farms in the foothill zone of the republic, when growing corn for grain in rain-fed conditions on typical chernozems (with a sufficient level of soil supply with nitrogen, mobile phosphorus and exchangeable potassium), use mineral fertilizers at a dose of N₆₀P₆₀K₆₀ or N₉₀P₆₀K₆₀. Also, the optimal doses of mineral fertilizers for cultivating corn for grain in the steppe zone should be considered N₁₅₀P₆₀K₉₀. When cultivating corn for silage, the dose of nitrogen should be increased at the same ratio of phosphorus and potassium. The highest yields of green mass were obtained by variants N₁₈₀P₁₂₀K₁₂₀ and N₁₈₀P₉₀K₉₀.

Keywords: corn hybrid, Krasnodar 291 AMV, dry matter, weight of 1000 grains, fiber, payback per kg of active substance

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Daily periodicity and rhythm of linear growth of corn in the foothill zone of Kabardino-Balkaria

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Abstract. The article examines the daily periodicity and rhythm of linear growth of corn in the conditions of the foothill zone of Kabardino-Balkaria. The purpose of the study is to establish the daily growth of corn in dynamics depending on the sowing time. Field experiments were conducted in 2021-2023. in the educational and production complex of the Kabardino-Balkarian State Agrarian University named after V.M. Kokov. The experiments were carried out on leached chernozem. The experimental plot was characterized by the following agrochemical

indicators: humus content in the arable horizon – 3.3%, total nitrogen – 0.28%, absorption capacity – 34.4 mg·equivalent per 100 g of soil, the reaction of the soil solution is neutral (pH – 7). The content of mobile phosphorus was 15.0 mg per 100 g of soil, that is, the average supply (according to Chirikov), the supply of exchangeable potassium was increased - 15–18 mg per 100 g of soil (according to Chirikov). The mechanical composition of this soil is heavy loamy. The content of physical clay in it was 57%. It was established during the study that unevenness and a daily growth pattern close to sinusoidal are also characteristic of corn, as well as other crops of the cereal family. The dominance of thermal determinacy in growth fluctuations in corn is even more clearly expressed due to its increased heat requirement. In this culture, during the day, not only the phase of the minimum in the growth and temperature curves, but also the maximum coincides in time. The largest hourly increases (4.5 mm/h) occurred at 3 p. m., when the average temperature reached 22.1°C, and the smallest (1.5 mm/h) were noted at 4–6 p. m. at a temperature of 7.5°C. With this temperature variation, the half-life of the descending part of the growth curve was 14 hours, and the ascending part was 10 hours.

Keywords: corn hybrid, Spring 179 SV, growth rate, air temperature, duration of sunshine as a percentage of an hour, relative air humidity

ANIMAL SCIENCE AND VETERINARY MEDICINE

Private Animal Husbandry, Feeding, Feed Preparation and Livestock Production Technologies

UDK 636.32/.38:636.03

Productivity of Caucasian breed sheep with different degrees of lamb wool crimp at birth

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Abstract. In this article, the authors offer production one of the effective methods for predicting valuable economically useful traits at an early age based on the degree of wool crimp in lambs 4-5 days after their birth. Based on the research and production experiments carried out, it has been established that raising young sheep with an average degree of crimp in wool fiber can increase and improve the quality of sheep products. The largest percentage of elite and first-class bright females was isolated among sheep with an average degree of crimp of 87.4%, and among sheep of the same age with fine and coarse crimp, such animals were 80.6 and 71.3%, respectively. Individuals with medium tortuosity (15.1 kg) were characterized by a higher slaughter weight; among peers with fine and coarse tortuosity, this characteristic was 13.9 and 13.2 kg, respectively, which is less than in young animals with average tortuosity by 8.6, respectively. ($P < 0.05$) and 11.4% ($P < 0.05$). In terms of slaughter yield, animals with medium tortuosity also had an advantage (44.6%), and peers with fine and coarse tortuosity were inferior to animals with average tortuosity in this indicator by 1.5 and 2.1 abs., respectively. %. It is recommended that scientists and practicing sheep breeders use one of the effective methods for assessing the degree of wool crimp at the first birthdays, as an effective method of the selection process, giving preference to animals with medium crimp.

Keywords: ewes, lambs, breed, wool crimp, meat and wool productivity, economic efficiency

Influence of broiler chick keeping method on meat production efficiency

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Abstract. This article presents the results of a research aimed at identifying the effect of floor and cage housing of broiler chickens on the efficiency of meat production. Experimental studies were conducted in JSC "Lindovskaya poultry farm – breeding plant" of Nizhny Novgorod region in the period of 2022-2023. The object of the study was broiler chickens of Arbor Acres cross. The parameters were studied: the dynamics of changes in live weight, average daily, absolute and relative gains, safety, feed consumption and conversion, slaughter indicators (slaughter yield, weight of carcass), carcasses distribution into 1 and 2 grades, meat production for the whole batch and per 1 m² of production area poultry houses. The comparative characterization of the obtained indicators is given and the economic efficiency of broiler chicken meat production is calculated. It is established, that indicators of live weight, average daily and absolute gains, and also slaughter indices in the group of broiler chickens with floor housing were superior to the peers of the experimental group. However, the indicators of preservation, feed consumption and conversion, meat production per 1m² were better in the group with cage housing. As a result of calculation of economic efficiency it was found that when using the cage keeping method profit per 1 kg of sold products is 7.69% higher than with the floor method of housing. At cage keeping broiler chickens the level of profitability of production increases by 3.9% in comparison with the floor method. Due to increased utilization of production areas – arrangement of cages in 4 tiers at the cage method of keeping, it is possible to increase the efficiency of meat production of broiler chickens.

Keywords: meat hens, keeping on deep litter, cage keeping, growth intensity, feed consumption, meat productivity

UDK 636.598.082.4(470.57)

Planting density of geese as a way of influence on reproduction and organization of poultry production

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Abstract. The presented article discusses the final values of the indicators of safety and reproduction of the compared breeds of geese. In modern production of goose products, the task is to increase productivity while increasing feed conversion. Based on this, it is necessary to improve the technological parameters of keeping geese of the parent flock, depending on the breed characteristics. The object of the study were geese of the Kuban (light type), Large Gray (heavy type), and White Hungarian breeds (medium type). A targeted assessment of stocking density is determined taking into account the following criteria - age of geese, live weight of the bird, type of poultry house. The goal of the work was to establish a connection between stocking density and the reproductive qualities of the compared groups. When conducting the study, zootechnical, physiological, biometric and economic methods were used. During the experiment, it was found that diseases of the bird's limbs, a decrease in viability, a decrease in productivity and reproduction values, as well as an increase in the amount of feed consumed by birds is due to incorrect calculation of the stocking density of birds on farms. When identifying the rational stocking density of geese, the optimal parameters of egg production and live weight were determined. Thus, the best indicators were obtained when keeping geese of the parent flock with a stocking density for the Kuban breed (light type), which was 1.8 heads/m², for a large gray breed (heavy type) – 0.9 heads/m² and for the white Hungarian breeds (medium type) – 1.3 heads/m².

Keywords: geese, livestock safety, live weight, egg production, hatching eggs, gander sperm

Productivity and biological characteristics of young cattle of beef breeds and different types

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Abstract. Based on the research results obtained in the process of studying the growth and development of intrabreed types of specialized meat breeds, it is necessary to take into account that animals of the compact type in the postnatal period have a higher growth rate, therefore feeding should be complete, ensuring a high natural ability of animals at this time to synthesize muscle protein. In connection with the tasks of growing beef production, there is a need not only to increase the number of beef cattle, but also to increase its productivity through the development and implementation of accelerated production methods for creating highly productive beef herds, using modern selection methods based on modern advances in genetics. Using modern immunogenetic methods, it is possible to establish the origin of breeds and lines, and identify variants of the relationship with the productivity and resistance of the animal. When studying complementary and lysozyme activity, the results obtained indicate that the same pattern is observed in the process of ontogenesis. The maximum value of humoral factors is achieved by the age of 13-15. During later age periods, the value of humoral factors decreases slightly. When selecting a breed, it is necessary first of all to take into account which of them is most adapted to the given natural, climatic and economic conditions. To obtain a return on the production and increase its profitability, it is advisable to use heavy meat breeds, which allow the full realization of the genetic potential and high-quality beef by 15-18 months of age. When assessing animals for slaughter qualities, we also established differences between intrabreed types. Thus, Hereford bulls of the compact type exceeded their peers of the tall type in live weight at the age of 8, 12, 15 months by 12.5; 10.6; 9.7%, whereas already at the age of 18 months they were inferior to them by 4.3%. The same trend was observed according to the results of studies of the compact and tall types of the Kalmyk breed, where the superiority up to 15 months was 2.4, respectively; 3.5; 7.1%, and at the age of 18 months they were already inferior by 1.4%.

Keywords: cattle, meat productivity, cultivation, constitution, resistance

Breeding, Selection, Genetics and Biotechnology of Animals

Breeding of a new breed type "Ingush" of the grey mountain Caucasian breed of bees, adapted to local climatic conditions

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Adil-Azit S. Katsiev, Khamzat H. Evloev**

Abstract. Work was carried out to breed a new (Ingush) type of gray mountain Caucasian bee breed using an improving (introductory) crossing of local bees with highly productive breeds of domestic and foreign origin. Development, honey productivity and behavior were studied in the resulting crossed offspring. The results of the conducted studies showed higher incubation and honey productivity in the control groups Karnik Troizek, Carpathian and gray mountain Caucasian 19 and 18 frames and experimental (mixed) ♀ Carpathian × ♂ SGK and ♀ Karnik

Troizek ♂ SGK 20 frames, respectively. The crossed groups of the Ingush type of the gray mountain Caucasian breed, obtained by improving the crossing of local bees with highly productive breeds of various origins, contribute to an increase in the production of bee products, more efficient use of a diverse natural forage base of beekeeping. Of all the examined groups, the group of the genotype "Buckfast B8 (RKR) × ♂ SGK" showed the greatest aggressiveness, no significant differences were found in the other groups, peacefulness and moderate aggressiveness were observed. According to wax production and propolis, the best indicators are in the gray mountain Caucasian breed and its crossbred groups, which is 256 and 223 in the control group; crossbred – ♀ Karnik Troizek 1075 × ♂ SGK – 275 and 240; ♀ SGK × ♂ Karnik Troizek 1075 – 270-235; ♀ SGK × ♂ Karpatka – 256–222 respectively. The superiority of crossbred groups over purebred families shows that despite the weather and feeding conditions, as well as the protracted development of bee colonies in the spring period, the effect of heterosis appeared.

Keywords: heterosis, apiary, honey plants, hives, bee bread, honey, incubation, purebred families, crossing, type, breed

UDK 636.32/.38.082

The intensity of selection and its relationship with the breeding differential and productivity in a herd of merino sheep

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Natalia N. Kolosova, Ekaterina V. Aboneeva**

Abstract. The results of sheep breeding depend to a great extent on the possibility to use as repair young stock the animals maximally approaching the level of productivity traits to the target standard of the flock. At expanded reproduction of the flock the necessity to use maximum number of young stock for repair is obvious. However, an increase in the number of young stock introduced into the herd of repair stock to increase the herd size leads to a decrease in the speed of breeding progress. In order to predict the dynamics of possible changes, a selection experiment is used. The selection experiment was conducted in the breeding flock of merino sheep of Salsa breed in LLC "Belozernoye" of Salsky district of Rostov region. The aim of the research was to evaluate the prospects of the rate of change in the productivity of Salsa sheep at different selection intensity for two main economic and useful qualities. The tasks of the research, in order to achieve the specified goal, included: carrying out the boniting of young stock and ewe sows of the selection group, calculation of the parameters of selection differential, estimation of the change of another productivity component at different selection intensity by the priority feature of selection. The results were processed by calculating the arithmetic mean and its error for the whole sex-age group, as well as at selection intensity of 20, 40 and 80% of the best animals. The selection differential was calculated by the formula: $SD = M_1 - M_2$, where SD – selection differential; M_1 – average index of selection trait in the selected group of sheep; M_2 – average index of selection trait in the sex and age group of sheep without selection. The most effective tandem selection proved to be for increasing physical wool shearing. It is useful to extrapolate the results of research to the group of rams-producers evaluated by the quality of offspring. It is reasonable to use the obtained materials as a model of breeding process management in the population, means of analyzing its condition and adjusting the dynamics of development.

Keywords: sheep breeding, selection differential, selection intensity, live weight, wool shearing

AGROENGINEERING AND FOOD TECHNOLOGIES

Technologies, Machines and Equipment for the Agro-industrial Complex

UDK 634.1:631.6.02

Technological and technical support for anti-erosion landscaping in foothill and mountain garden agricultural landscapes

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Yuri A. Shekikhachev, Luan M. Khazhmetov**

Abstract. The methods used in practice for developing slopes for fruit crops have significant drawbacks: low area utilization and disruption of the humus layer of the soil, which leads to increased processes of water and wind erosion. The construction of stepped terraces is associated with a low utilization rate of slope lands and requires significant one-time capital investments. In this regard, the development of a new type of terraces, providing anti-erosion protection for areas in foothill and mountain garden agricultural landscapes and increasing the slope utilization rate, is relevant in the conditions of the Central part of the North Caucasus. The purpose of the study is to develop a new terrace design that will provide anti-erosion protection for areas in foothill and mountain garden agricultural landscapes and increase the slope utilization rate. The object of study is a new terrace design. Physical modeling methods were used during the research. During the research, the features of the most used terrace designs were analyzed, their shortcomings were identified, and a new method of constructing terraces was developed, which has technological and design differences. The existing design of stepped terraces with four elements is simplified to two sheets with a given profile and a cut-and-fill slope with a uniformly straightened profile, which is quickly sodded. It has been established that when cutting the seventh terrace in a row, the area for an additional terrace with a blade width of 5 m on a slope of 14-16° is saved. In terms "of per hectare" of terraced slope, the resulting additional area of the canvas is sufficient for cultivating 100 fruit trees planted intensively according to a 5×2 m scheme.

Keywords: mountain and foothill territories, slope lands, development, soil erosion, erosion control device, terraces, garden agricultural landscapes

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Preservation and corrosion protection of agricultural machinery in the conditions of KBR

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Abstract. The article discusses the main problems of ensuring the safety of agricultural machinery and protecting them from corrosion processes. The analysis of storage and anticorrosive protection of agricultural machinery is carried out. The assessment of the factors influencing the processes of corrosion and corrosion-mechanical wear in the conditions of agricultural production of KBR is given. The main estimated indicators of the safety of machines and indicators of the safety of combine harvesters are presented. A brief technique for optimizing

machine retention has been developed. The general principles of the system for ensuring the safety of the machine and tractor fleet during the off-duty period are considered. The nature and features of corrosion damage of parts and assembly units of agricultural machinery have been studied. As a result, the parts and assembly units that are most susceptible to corrosion and wear have been identified. It was revealed that 70-80% of machine parts fail due to the combined effects of atmospheric corrosion and mechanical loads. Of these, 20-25% are due to breakdowns from overloads during operation due to loss of strength, due to atmospheric corrosion. The classification of the atmosphere according to the level of pollution and typical agricultural environments according to the degree of danger of corrosion effects is made. The data on the corrosion activity of mineral fertilizers per year are presented. The mechanism of corrosion-mechanical wear of agricultural machinery interfaces is described, the nature of the destruction and the nomenclature of the interfaces most confirmed for this destruction are given.

Keywords: agricultural machinery, combine harvesters, machine parts, storage and preservation of machines, estimated indicators, atmospheric corrosion, corrosion protection, optimization of machine preservation methods

UDK 637.11:637.03

Partial components of dairy animal technology and equipment in the mountain conditions

Albert B. Baragunov

Abstract. The article deals with the problem of cow's milk production in mountain pastures using technical means of machine milking and its primary processing. In the process of researching the designated area of the national economy, a number of problems have been identified, the solution of which is devoted to the presented materials. The disadvantages of cow's milk production with the maintenance of dairy livestock in mountain pastures, which differ from the usual conditions of management using serial technical means of milk production, milk cooling and its primary processing, are determined. The main distinguishing feature affecting the conduct of production is the reduced atmospheric pressure, which directly affects the operation of the milking equipment. Taking into account the natural and climatic conditions of the dairy livestock in the mountain pastures of the proposed cow milking equipment, the technology of dairy production has been developed. The technology includes basic operations for feeding and caring for dairy cattle, milk production processes, primary processing and storage of drinking cow's milk. The article offers recommendations on milking technology and equipment maintenance, taking into account the characteristics of mountain pastures. As a result of the study, conclusions were formulated on the need to take into account climatic conditions (ambient temperature and atmospheric pressure) when operating dairy equipment for servicing dairy livestock in mountain pastures. It was revealed that the stiffness of the nipple rubber affects the milking speed. In case of deviation of the established stiffness of the nipple rubber in order to increase the service life and maintain the proper milking speed, a stand for its regulation is proposed. The regulatory frequency of technical care is recommended.

Keywords: milking, cow, mountain pastures, milking machines, production technology, milk

Food Systems

UDK 663.86.054.1

Study of processed grape and hibiscus products as promising raw materials for the production of extracts with increased antioxidant properties

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Abstract. In the modern world, the lifestyle and diet of the population has changed significantly. Such changes also affected the health, endurance, ability to work and emotional state of people. First of all, the state of people's health is affected by the diet, since with food a person consumes all the necessary and vital micro- and macroelements. Antioxidant phenolic compounds and plant pectins are attracting increasing attention as research subjects because they have antioxidant and immunomodulatory properties when consumed regularly. In this regard, the purpose of the research was to study plant raw materials with increased antioxidant properties used for use in the production of functional drinks. The objects of study of biologically active compounds were grape pomace of red grape varieties and hibiscus flowers. Physico-chemical indicators of raw materials were determined, confirming the high content of pectin substances in grape pomace, on average for varieties – 3.77%, polyphenolic substances – 3227.83 mg/dm³. In hibiscus, the polyphenol content was 1227.2 mg/dm³. The established data confirm the technological properties of the raw materials for obtaining extracts. Extracts were obtained by acid and aqueous hydrolysis. It was established that during extraction the loss of biologically active substances is insignificant; organoleptic evaluation showed the attractiveness of the extracts for future drinks. The proposed raw materials can be recommended for the production of extracts used as a basis for drinks with increased antioxidant and radioprotective properties.

Keywords: pomace, extract, pectin, drinks, antioxidants, hibiscus, polyphenolic substances, anthocyanins

UDK 664.748:664.68

Practical justification of the application of the ozonation process of raw materials in the technology of flour confectionery products

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Abstract. The article deals with the problem of safety and quality of flour confectionery products. It seems relevant to use an innovative method of ozonation of raw materials, which reduces the risk of contamination and improves the quality of flour confectionery products. The purpose of the work was to provide a practical justification for the application of the ozonation process of raw materials in the production of flour confectionery products. The study was carried out on samples of oat flour, wheat bakery of the highest grade and oatmeal talkan, subjected to the ozonation process for 5, 10 and 15 minutes. The influence of the ozonation process on the microbiological, physico-chemical and structural-mechanical properties of raw materials was assessed. It is proved that ozonation of raw materials reduces microbiological contamination. It has been established that the optimal ozonation time is 15 minutes. The physico-chemical parameters of the raw materials did not change after ozonation, while the process had an inhibitory effect on enzymes, which makes it possible to recommend ozonation for processing flour with increased sugar-forming ability. The results of the analysis on the alveograph and pharynograph allowed us to judge that the increase in the ozonation time to 15 minutes. it affects the rheological properties of the dough and leads to an increase in its elasticity, a decrease in

extensibility. Ozonation leads to an increase in water absorption capacity, which affects the structure of the dough and the porosity of the finished product. The results obtained suggest the effectiveness of ozonation in the technology of flour confectionery products and confirm the need for further research in this area.

Keywords: ozonation, flour confectionery products, microbiological indicators, quality of raw materials, rheology of dough

UDK 663.5:663.81

Methods for stabilizing of semi-finished products and alcoholic beverages against colloidal opacities

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Abstract. This work is devoted to identifying changes in the physicochemical parameters of semi-finished products and alcoholic beverages when they are treated with cold and fining agents. The research was carried out in the conditions of Elbrus Spirits LLC and at the Department of Technology of Production and Processing of Agricultural Products of the Kabardino-Balkarian State Agrarian University in 2021-2023. The objects of research were fruit drinks and juices made from rowan berries, apples and lingonberries. Alcoholized fruit and berry fruit drinks and juices were treated with cold at temperatures: minus 3 + minus 6°C. Trial processing of alcoholized juices showed that the optimal dose of PVP for rowan and lingonberry juices is 200 mg/l, apple – 20 mg/l. It has been established that when treated with PVP and bentonite, the amount of phenolic substances in the juice is significantly reduced. When processing alcoholized juices according to this scheme, no noticeable change in the content of pectin substances was observed. To prevent colloidal opacities, the following types of treatments are recommended: - cold treatment, which consists of cooling semi-finished products or blends to a temperature (minus 3 + minus 6°C) and holding at this temperature for up to 48 hours, followed by cold filtration; - treatment with PVP and bentonite, for semi-finished products the dose does not exceed 200 mg/l, for blends 100 mg/l. The amount of bentonite used in this case is 0,5-1,0 g/l. It was noted that there is a direct proportionality between the amount of added gelatin and the separated phenolic substances; the maximum content of polyphenols bound by a unit of gelatin was noted with a minimum dose of gluing material. Observation of the stability of the processed drink showed that the optimal dose of gelatin is 50 mg/l. When treated with the indicated dose in combination with 0.5 g/l of bentonite, the drink retains its presentation for 8 months, the control sample – 2 months.

Keywords: alcoholic beverages, semi-finished fruit and berry products, durability of drinks, cold treatment, fining, physico-chemical parameters

ECONOMY

UDK 338.436.33:004.9

Russia's food security in the context of digitalization of agriculture

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Abstract. The article examines the issues of the formation of the Russian food security system in the context of digitalization of the agro-industrial complex. It is indicated that the agro-industrial

complex and its second sphere – agriculture – solves vital socio-economic tasks of the country's development, including ensuring the necessary level of food security. It is noted that agriculture is subject to the negative influence of a number of factors: climatic, economic, financial, demographic, political, etc. All this significantly increases the risk burden, leads to a decrease in the sustainability of both agricultural production and the food security system. The current situation is characterized by fierce competition, a decrease in investments in fixed assets of agricultural organizations, the need to promptly solve problems of import substitution, achieve technological sovereignty, etc. The solution of these problems requires the use of a new technological development base. It is argued that the digitalization of the agro-industrial complex gives certain features to the process of forming a food security system. The external and internal conditions that form a negative background for the development of agriculture and food security (increased urbanization, uncoordinated expansion of anthropogenic activities, land degradation, deforestation, etc.) are highlighted and analyzed. The article analyzes the factors directly impeding the development of digitalization in the Russian agro-industrial complex (sanctions pressure, low-effective mechanisms for achieving technological sovereignty, restrictions, related to ITS, the established management culture, low competence of staff, dependence on imported software, fears of switching to new tools, etc.). It is noted that digitalization raises the development of agriculture to a new qualitative level and, as a result, ensuring food security. Agriculture is becoming a high-tech industry. Digital technologies make agriculture less dependent on climatic conditions, significantly improve the effectiveness of risk management and reduce the severity of related threats. It is concluded that the digitalization of the agro-industrial complex should be carried out comprehensively, with due state support, with the development and implementation of a strategy and programs for the digitalization of the agro-industrial complex.

Keywords: digital technologies, food security, robotic complexes, precision agriculture, management culture, food security index, digitalization index