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DISSEMINATION AND DEVELOPMENT OF SEPTORIOSIS IN SPRING WHEAT, DEPENDING ON WEATHER CONDITIONS IN THE NORTH OF KAZAKHSTAN

Abstract. Wheat is the main product in 53 countries, including in our country. The leading producers of wheat grain in Kazakhstan are Akmola, Kostanay and North Kazakhstan regions. The virulence of previously weakly pathogenic pathogens, for example, spotted wheat leaves caused by many imperfect fungi from the genera Septoria and others, has increased. The purpose of the study is to conduct phytosanitary monitoring of the spread and development of spring wheat septoria and to study the influence of weather conditions on the development of the disease. The technique is generally accepted in phytopathological studies. In 2018, favorable weather conditions were elaborated for the development of Septoria on spring wheat. A high correlation in all studied varieties was observed between the degree of manifestation of the disease and the number of days with precipitation > 1 mm. 2019 was an unfavorable year for the development of septorious spots, the disease was depressed. A close negative correlation was found on all wheat varieties between the degree of development of the disease and the number of days with precipitation > 1 mm. Phytosanitary monitoring of the spread and development of spring wheat septoria is required annual monitoring to conduct a complex of preventive and protective measures to limit them.

Key words: Spring soft wheat, septoria, monitoring, phytopathological assessment.

Introduction. Kazakhstan is one of the largest wheat producers in the world. The climatic conditions in the north are very favorable for growing crops. Grain production has been and remains an important strategic resource and the basic agricultural industry of Kazakhstan [1]. In recent years, the Republic produces annually up to 20-22 million, and exports up to 5-8 million tons of grain. Under favorable weather conditions and high agricultural technology, spring wheat varieties created by breeders yield up to 1.5-2 tons of grain per hectare with a high gluten content [2]. However, the average yield of grain crops does not exceed 10-13 kg/ha, which is due to abiotic and biotic stresses, in particular, diseases that during the years of epiphytotic development reduce the yield to 10-25% or more [3,4]. The phytosanitary situation on wheat crops has changed significantly in recent years, as evidenced by the results of many years of disease monitoring. Significantly more frequent damage to the most harmful diseases (brown, stem rust), sometimes reaching the level of epiphytoties. Virulence of previously weakly pathogenic pathogens, for example, spotting of wheat leaves caused by many imperfect fungi from the genera Septoria and others, has increased. Septoria of leaves and ears for a long period of time remains one of the most common and harmful diseases of spring wheat in all areas of grain production [5,6,7]. The disease manifested itself even in years with severe drought (2003, 2010). Strong development of septoria was observed in 2013 and 2014 (distribution - 100%, intensity 40-60%, and the intensity on the ear - from 10 to 25%) [8]. As a result, there is an increase in the level of biotic stress in wheat agrocenosis, which is facilitated by both climatic changes in nature and anthropogenic impact on biocenoses. The aim of our research was to conduct phytosanitary monitoring of the spread and development of spring wheat septoria and to study the influence of weather conditions on the development of the disease.

Materials and methods. Monitoring the dynamics of the development of diseases was carried out on the production fields of LLP "SPCGF named after A.I. Barayev". Septoria spotting was the main and most

common disease of wheat leaves during the growing season. Examination of spring soft wheat crops for susceptibility to septoria was carried out every 10-12 days from the moment of exit to the tube until the phase of milk ripeness of grain. To account for the spread and development of wheat septoria in the fields diagonally at equal distances, 20 samples of 10 stems each were taken (figure).

Survey of wheat crops

The degree of leaf affection with septoria was determined according to the James international scale [9]. Observations of the development of septoria during the growing season were carried out on susceptible varieties Shortandinskaya 2012, Akmola 2 and Asyl sapa. To record the precipitation, temperature and relative humidity, we used a meteorological station. Statistical processing of the data was carried out according to the programs of biometric genetic analysis in crop production and breeding – Agros 2.11.

Results and discussions: The weather conditions of the spring wheat growing season in 2018 were favorable for the development of Septoria. The spread of the disease was 100%, and its intensity reached 46.17% (table 1).

Table 1 – Distribution and development of septoria in spring wheat varieties during the growing season, 2018

Varieties	Septoria spot, %	
	Dissemination	Development
Boot stage		
Shortandinskaya 2012	100	1,28
Akmola 2	100	1,58
Asyl sapa	100	0,85
Ear formation		
Shortandinskaya 2012	100	11,83
Akmola 2	100	19,01
Asyl sapa	100	11,56
Milky-wax-ripeness		
Shortandinskaya 2012	100	46,17
Akmola 2	100	40,97
Asyl sapa	100	42,93

To establish a functional relationship between the degree of development of Septoria in spring wheat and weather elements, a pair correlation analysis was performed. To assess the strength of the correlation coefficient correlation, the Cheddock scale was used. According to the results of the analysis on the variety Shortandinskaya 2012, a very high positive correlation was established between the degree of manifestation of the disease and the number of days with precipitation > 1 mm (r = 0.96) (table 2). An

average correlation was found between the degree of development of septoria with the amount of precipitation (r = 0.67) and the hydrothermal coefficient (r = 0.66). The average daily air temperature had an average negative relationship with the degree of damage to spring wheat with septoria (r = – 0.59).

In Akmola variety 2, a complete relationship was established between the degree of development of the disease and the number of days with precipitation > 1 mm (r = 1.0). No effect on the development of septoria of the remaining studied climatic factors was noted.

As a result of observations on the Asyl sapa variety, a clear dependence of the number of days with precipitations > 1 mm with leaf lesion septoria (r = 0.96) was found. The remaining studied weather factors had an average correlation with the degree of development of the disease.

Table 2 – The value of the correlation coefficient of the degree of developpment of Septoria in spring wheat varieties depending on weather and climate factors, 2018

Varieties	Daily average Temperature air, ° C,	Number of precipitation (mm)	Number of days with precipitation > 1 mm	Hydrothermal coefficient
Shortandinskaya 2012	-0,59	0,67	0,96	0,66
Akmola 2	-0,39	0,48	1,0	0,47
Asyl sapa	-0,57	0,66	0,96	0,64
Average	-0,51	0,60	0,97	0,59

In 2019, during the entire period of plant vegetation, dry, hot weather was observed, which adversely affected the development of Septoria (table 3). The spread of the disease reached 100 percent, and the development was weak - up to 14%.

Table 3 – Distribution and development of septoria in spring wheat varieties during the growing season, 2019

Varieties	Daily average Temperature air, °C	Number of precipitation (mm)	Number of days with precipitation > 1 mm	Hydrothermal coefficient
Akmola 2	0,36	-0,54	-0,72	-0,53
Asyl sapa	0,57	-0,73	-0,87	-0,72
Shortandinskaya 2012	0,52	-0,69	-0,83	-0,68
Average	0,48	-0,65	-0,81	-0,64

Conclusions. Thus, in 2018 there were favorable weather conditions for the development of septoria on spring wheat. A high correlation in all studied varieties was observed between the degree of manifestation of the disease and the number of days with precipitation > 1 mm. 2019 was unfavorable for the development of septorious spots, the disease was depressed. A close negative relationship was found between the degree of disease development and the number of days with precipitation > 1 mm. Phyto-sanitary monitoring of the spread and development of spring wheat septoria requires annual monitoring to conduct a set of preventive and protective measures to limit them.

The work is performed under the grant funding program of the Science Committee at the Ministry of Education and Science of the Republic of Kazakhstan on the project "The role of resistant and tolerant to Septoria wheat species and their cultivation technology in the process of stabilization of phytosanitary condition of agroecosystems " (state registration № 0118PK01030).

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СОЛТҮСТІК ҚАЗАҚСТАННЫҢ АУА РАЙЫ ЖАҒДАЙЫНА БАЙЛАНЫСТЫ ЖАЗДЫҚ БИДАЙДА СЕПТОРИОЗДЫҢ ТАРАЛУЫ ЖӘНЕ ДАМУЫ

Аннотация. Ауыл шаруашылығы экономиканың маңызды салаларының бірі болып саналады, ол елдің азық-түлік қауіпсіздігін қамтамасыз етеді. Бидай 53 елде, сонымен қатар біздің елде негізгі өнім болып табылады. Қазақстан әлемдегі ең ірі бидай өндірушілердің бірі болып табылады. Солтүстіктегі климаттық

жағдай дәнді дақылдарды өсіру үшін өте қолайлы. Астық өндірісі Қазақстанның ауыл шаруашылығы өндірісінің негізгі саласы, маңызды стратегиялық ресурс болып табылады және солай болып қала береді. Соңғы жылдары республика жыл сайын 20-22 млн.тоннаға дейін астық өндіреді, ал 5-8 млн. тоннаға дейін астық экспорттайды. Ақмола, Қостанай және Солтүстік Қазақстан облыстары Қазақстанда бидай астығының жетекші өндірушілері болып табылады. *Septoria* және т.б. тұқымдастарынан шыққан көптеген жетілдірілмеген саңырауқұлақтар тудыратын, мысалы бидай жапырақтарының дақтары, бұрын әлсіз патогенді болған қоздырғыштардың вируленттілігі өсті. Ұзақ уақыт бойы жапырақтар мен масақтардың септориозы астық өндірісінің барлық аймақтарында жаздық бидайдың кең таралған және зиянды ауруларының бірі болып келеді. Ауру тіпті қатты құрғақшылық жылдары да байқалды. Эпифитотиялық даму жыл сайын байқалады, эпифитотиялық жиілігі – он жылдан бес жыл. Бұл ретте егіннің шығыны 20-дан 45%-ға дейін құрауы мүмкін. Зерттеудің мақсаты – жаздық бидай септориозының таралуы мен дамуына фитосанитарлық мониторинг жүргізу және ауа-райы жағдайының аурудың дамуына әсерін зерттеу. Фитопатологиялық зерттеулерде жалпы қабылданған әдістеме. Аурулардың даму динамикасын бақылау «А.И.Бараев атындағы астық шаруашылығы ғылыми-өндірістік орталығы» ЖШС өндірістік алаңдарында жүргізілді. Вегетациялық кезеңде септориозды дақ бидай жапырақтарының негізгі және кең таралған ауруы болды. Септориоздың дамуын бақылауды Шортандинская 2012, Акмола 2 және Асыл сапа қабылдағыш сорттарда жүргіздік. Жауын-шашынды, температураны және салыстырмалы ылғалдылықты тіркеу үшін метеорологиялық станция пайдаланылды. Келесі көрсеткіштер ескерілді: ауаның орташа тәуліктік температурасы, жауын-шашын мөлшері, жауын-шашын бар күндер саны және гидротермиялық коэффициент. 2018 ж. ауа-райы жағдайы жаздық бидайда септориоздың дамуы үшін қолайлы болды. 2019 жылы өсімдіктердің бүкіл вегетациялық кезеңінде құрғақ, ыстық ауа райы байқалды, бұл септориоздың дамуына теріс әсер етті. Жаздық бидайдағы септориоздың даму деңгейі мен ауа райы элементтерінің арасындағы функционалдық тәуелділікті анықтау үшін жұптық корреляциялық талдау жүргізілді. 2018 жылы аурулардың таралуы 100%-ды құрады, ал оның қарқындылығы 46,17% - ға жетті. Барлық зерттелетін сорттарда аурудың пайда болу дәрежесі мен жауын-шашын бар күндер саны > 1 мм арасында жоғары корреляциялық тәуелділік байқалды. Ауаның орташа тәуліктік температурасы аурудың көріну дәрежесімен орташа теріс байланыста болды. Жауын-шашын мөлшері мен гидротермиялық коэффициент зерттелетін белгімен орташа оң қатынасқа ие болды. 2019 жыл септориозды дақтардың дамуы үшін қолайсыз болды, ауру депрессияда болды. Бидайдың барлық сорттарында аурудың даму дәрежесі мен жауын-шашын бар күндер саны > 1 мм арасында тығыз теріс өзара байланыс анықталды. Орташа тәуліктік ауа температурасы аурудың пайда болу деңгейімен орташа оң байланыс болды. Жауын-шашын мөлшері мен гидротермиялық коэффициент зерттелетін белгімен орташа теріс қатынасқа ие болды. Жаздық бидайдың септориозының таралуы мен дамуына фитосанитариялық мониторинг жүргізу оларды шектеу мақсатындағы профилактикалық және қорғау іс-шаралар кешенін өткізу үшін жыл сайынғы бақылауды талап етеді.

Түйін сөздер: Жаздық жұмсақ бидай, септориоз, мониторинг, фитопатологиялық бағалау.

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РАСПРОСТРАНЕНИЕ И РАЗВИТИЕ СЕПТОРИОЗА НА ЯРОВОЙ ПШЕНИЦЫ В ЗАВИСИМОСТИ ОТ ПОГОДНЫХ УСЛОВИЙ НА СЕВЕРЕ КАЗАХСТАНА

Аннотация. Сельское хозяйство считается одной из наиболее важных сфер экономики, которая в значительной степени обеспечивает продовольственную безопасность страны. Пшеница является основным продуктом в 53 странах, в том числе в нашей стране. Казахстан является одним из крупнейших производителей пшеницы в мире. Климатические условия на севере очень благоприятны для выращивания зерновых культур. Производство зерна было и остается важным стратегическим ресурсом, базовой отраслью сельскохозяйственного производства Казахстана. В последние годы республика производит ежегодно до 20-22 млн., а экспортирует до 5-8 млн. тонн зерна. Ведущими производителями зерна пшеницы в Казахстане являются Акмолинская, Костанайская и Северо-Казахстанская области. Возросла вирулентность ранее слабопатогенных возбудителей, например пятнистостей листьев пшеницы, вызываемых многими несовершенными грибами из родов *Septoria* и др. Септориоз листьев и колоса в течение длительного периода времени остается одной из наиболее распространенных и вредоносных болезней яровой пшеницы во всех зонах производства зерна. Заболевание проявлялось даже в годы с жесткой засухой. Энфитотийное развитие отмечается ежегодно, частота эпифитотийного – пять лет из десяти. При этом потери урожая могут составлять от 20 до 45%. Цель исследований – проведение фитосанитарного мониторинга распространения и развития септориоза яровой пшеницы и изучение влияния погодных условий на развитие болезни. Методика –

общепринятая в фитопатологических исследованиях. Наблюдения за динамикой развития болезней осуществляли на производственных полях ТОО «Научно-производственном центре зернового хозяйства имени А. И. Бараева». Септориозная пятнистость была основным и наиболее распространенным заболеванием листьев пшеницы в период вегетации. Наблюдения за развитием септориоза вели на восприимчивых сортах Шортандинская 2012, Акмола 2 и Асыл сапа. Для фиксирования выпадения осадков, температуры и относительной влажности использовали метеорологическую станцию. Учитывались следующие показатели: среднесуточная температура воздуха, количество осадков, количество дней с осадками и гидротермический коэффициент. Погодные условия вегетационного периода яровой пшеницы 2018 г. были благоприятными для развития септориоза. В 2019 году в течение всего периода вегетации растений наблюдалась сухая, жаркая погода, что неблагоприятно сказалось на развитии септориоза. Для установления функциональной зависимости между степенью развития септориозом на яровой пшенице и элементами погоды проводился парный корреляционный анализ. В 2018 году распространение болезней составило 100 %, а ее интенсивность достигала 46,17 %. Высокая корреляционная зависимость на всех изучаемых сортах наблюдалось между степенью проявления болезни и количеством дней с осадками > 1 мм. Среднесуточная температура воздуха имела среднюю отрицательную связь со степенью проявления болезни. Количество осадков и гидротермический коэффициент имели среднюю положительную связь с изучаемым признаком. 2019 год был неблагоприятным для развития септориозных пятнистостей, заболевание находилось в депрессии. Тесная отрицательная взаимосвязь на всех сортах пшеницы обнаружена между степенью развития болезни и количеством дней с осадками > 1 мм. Среднесуточная температура воздуха имела среднюю положительную связь со степенью проявления болезни. Количество осадков и гидротермический коэффициент имели среднюю отрицательную связь с изучаемым признаком. Проведение фитосанитарного мониторинга распространения и развития септориоза яровой пшеницы требует ежегодного наблюдения для проведения комплекса профилактических и защитных мероприятий по их ограничению.

Ключевые слова: яровая мягкая пшеница, септориоз, мониторинг, фитопатологическая оценка.

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INFORMATION TECHNOLOGIES IN GRAIN MARKET INFRASTRUCTURE OPERATIONS

Abstract. The directions of development of innovative process, one of the key factors of development of agriculture - introduction of tools of digitalization applied in Kazakhstan are considered. It is noted that initially digitalization was actively introduced in animal husbandry due to the fact that the main share of animals was concentrated in a private farmstead, which had significant risks in the organization of veterinary safety, complexity in carrying out complex veterinary measures. The use of information systems AgroStrea, which allows to collect a large amount of data of different variations of technologies, varieties, crops, is presented to determine the best performance. An important task facing the state is the implementation of international requirements and norms of the EAEU to ensure the control of food safety of products delivered to Kazakhstan from third countries and exported from the country to other States. This will allow to realize the domestic export potential of branches and spheres of agriculture, which will change the volume of production, will contribute to a significant increase in the technological development of agriculture in Kazakhstan. The activity of "AgroStream" LLP, which is the developer of the methodology of transformation and implementation of information systems, is considered. It is noted that the use of the new module of IP "AgroStream – "AgroMap" mobile application will allow to organize the effective work of agronomists. Informatization of production, operation, management and services in agriculture with the introduction of digital technologies is aimed at transforming the model of agricultural turnover, stimulating the development of industrial parks and electronic trade in agricultural products.

Key words: agriculture, digitalization, technologies, systems, efficiency, production, products, innovations, implementation, organization.

Introduction. In modern conditions, the innovation process is a single and continuous flow of turning specific technical or technological ideas based on scientific developments into modern technologies or individual components of technological solutions and bringing them to use directly in production in order to obtain qualitatively new products. The company regulates the course of the innovation process in General and in individual sectors by developing and implementing an appropriate innovation policy, the purpose of which is, first of all, to bring scientific and technical developments to their practical use.

The most active direction of development of innovative process in modern conditions is the organization of introduction of scientific achievements in production [1].

The practice of implementing innovations in agriculture, as a rule, indicates a difference in the levels of technical and technological development of economic entities that are participants in the innovation process

According to experts, 25% of the world economy by 2020 will move to the introduction of digitalization technologies [2]. that is Why, in order to reduce costs, increase productivity and optimize the working process, one of the key factors in the development of agriculture is the introduction of digitalization tools, which are also actively used in the Republic of Kazakhstan.

Research methodology. In the next five years, the country plans to create 20 digital farms and 4 thousand farms using separate digital technologies.

Currently, the processes of maintaining the register of permits in the field of issuing certificates in animal husbandry and crop production, the organization of monitoring the passage of goods in import and

export operations are more digitized. Data exchange with the Russian veterinary monitoring system on the issued export permits has been implemented quite effectively. Fully automated monitoring processes and the operation of the turnover of grain receipts. The process of automating the issuance of subsidies in agriculture is being completed.

It should be noted that initially more actively digitalization was introduced in the field of animal husbandry due to the fact that before the market reforms the main share of animals was concentrated in a private farmstead, which represented certain risks in the organization of veterinary safety and greater complexity in carrying out complex veterinary measures.

Research results. The results of the analysis conducted in the country of the current state of introduction of precision agriculture with the division into "advanced" and "digital" farms showed that there are 114 advanced and 10 digital farms in the country. By 2022, the goal is to bring the value of the indicator to 2 thousand advanced farms throughout the country [3].

A digital farm is a farm that can operate through the application of new tools and technologies, with almost no human intervention. The main objective of digitalization is to simplify the activities of farmers from the beginning of activity to the sale of products.

Due to new technologies, training and professional development of agricultural sector workers will be carried out, for which in 2020 it is planned to launch an online training program with the involvement of private it companies. Students will be given the opportunity to choose their courses and teachers remotely, which will significantly reduce the time and transport costs of farmers [4]. Rural producers will be taught the basics of entrepreneurship, farming, agronomy, seed production, animal husbandry. In 2019, a pilot project was implemented to launch online lending for spring field work, in 2021 this process will be fully automated.

Since the process of obtaining land at auctions and auctions was not automated and there was practically no open map of land plots, until July 1, 2019, the provision of land only in electronic form was carried out in some regions in a pilot mode, while by the end of 2019 it is planned to create an open map of land plots, and from 2021 to launch the process completely.

As an example of effective management decisions, consider JSC "Atameken-agro", which began its activities in 2003 and by 2014 began to search for solutions to digitalize the company's activities.

In 2016, "AgroStream" LLP offered its services for the implementation of the planning module of technological maps for "Atameken-agro". This was due to the fact that there was an urgent need for rural producers in effective technologies for carrying out plan-fact analysis, control of theft and exclusion of losses. Therefore, the planning module was transformed into a full-scale information system "AgroStream" – the only domestic company offering a comprehensive product. "AgroStream" combines the experience of advanced foreign developments, but at the same time is maximally adapted for the Kazakh consumer. Simplicity of the interface, intuitiveness of reporting, informativeness and complexity are the main competitive advantages of the proposed product.

The results of the implementation were expressed in a significant reduction in theft and loss, in strengthening control over the implementation of specified technologies. This, in turn, led to an increase in crop yields. But the main goal in the development and implementation of IP "Agrostream" in the activities of JSC "Atameken-agro" was not so much to reduce losses and reduce the impact of the human factor, as to collect the necessary amount of data. On the basis of management information, it became possible to gradually move to precision farming and get the opportunity to determine the most effective technologies, select more marginal varieties, understand which crops give the best return in our climatic conditions. All this will make it possible in the future to take a differentiated approach to planning for each field.

The use of AgroStream information systems allows to collect a large amount of data of different variations of technologies, varieties, crops, etc. in order to determine the best performance. However, the most difficult in the implementation process was the training of personnel. The main problem was not even in training, but in instilling an understanding of the need for innovation, in the psychological acceptance of the idea as such. It was necessary not only to install the program, but also to change the thinking of the staff.

At the same time, thanks to constant training, user support and operational technical support, it was possible to achieve mutual understanding with the personnel of agricultural producers involved in the implementation process. The corporate policy of JSC "Atameken-agro" helped to achieve this result, as all

important issues in the company are taken collectively by the team. This not only raises the spirit of the staff, but also contributes to the maximum effectiveness of the strategy and everyone's involvement in the common cause. The staff of "Atameken-agro" is ahead of other domestic agricultural enterprises in the understanding and awareness of the development strategy and digitalization of activities. The official partner of AgroStream is TerraPoint, specializing in automation technologies in agriculture.

LLP "AgroStream" is not just a developer of the system, but also a professional consultant, he developed a methodology for the transformation of the consciousness of users and the introduction of information systems, up to the audit of all business processes. Only such an approach can give the expected results for the transition to precision agriculture.

Active work on introduction and use of the new module of IP "AgroStream" – "AgroMap" – the mobile application which is directed on the effective organization of work of the agronomist is continued. Negotiations are underway to integrate with artificial intelligence, where the user, by clicking on any point of the field map, will be able to determine the likelihood of diseases and pests, to receive unique recommendations for the implementation of preventive actions.

An urgent task facing the state at the present time is the implementation of international requirements and norms of the EAEU to ensure the control of food safety of products entering the Republic of Kazakhstan from third countries, as well as exported from the country to other EAEU States. The fulfillment of the requirements will allow to realize the national export potential in the field of agriculture, which will change not only the volume of production, but also will contribute to the increase of technological development of the country's agriculture.

The experience of such States as the USA, Canada and Australia shows that the informatization of production, operation, management and services in the introduction of digital technologies in this sphere is aimed at transforming the model of agricultural turnover, stimulating the development of industrial parks and electronic trade in agricultural products, accelerating the demonstration and dissemination of digital technological achievements in agriculture, but also, ultimately, contributes to the stable economic development of rural areas, taking into account their specific characteristics [5].

The experience of the leading countries, whose economies are characterized by a developed agricultural sector, shows that at one time each of them passed a kind of "technological revolution". For example, classical extensive agriculture is now being replaced by precise (precision), geoinformation technologies are more widely used, multi-operational energy-saving agricultural units are being introduced, high-yielding plant varieties are being selected and highly productive animal breeds are being bred. According to the research Agency RolandBerger, every year only in Asia, about 20% of the potential growth is provided by the use of innovative technologies in the field of agriculture.

In Australia, for example, introduced a system of identification and traceability of farm animals and products, which includes a complete package of software modules with the ability to accurately track animals throughout their lives and identify all the animals and objects with which they were in contact during their life cycle, which allows you to quickly and effectively respond to the emergence of various diseases at the time of their occurrence. This reduces the cost of the combined costs associated with disease spread, industry support, and market closure.

In the Russian Federation, within the framework of the State program "development of the fishery complex", work is being carried out on the development and implementation of the software and technical complex "Electronic fishing journal". The electronic journal allows recording and transmission of information on the implementation of fishing activities in electronic form, as well as provides remote access to information on the results of fishing.

For the development of agriculture is necessary to provide automated monitoring of the treated soil, to assist in the digitization of agriculture (including agriculture, livestock, fishing, cultivation, mechanization), to create a platform safety control of agricultural products covering all administrative departments at all levels to improve the information system of rapid response [7].

In order to further develop the agricultural sector it is planned:

- automation of the process of subsidizing agriculture, which would contribute to increasing the transparency and efficiency of subsidies, operational control over the development of allocated funds;

- the development of automation of registration, pledge, issuance of agricultural machinery and issuance of driver's licenses will allow to promptly provide public services in the field of technical

inspection for the population, to conduct centralized monitoring and control over the technical condition of agricultural machinery and compliance with legislation in the field of technical control and road safety;

- automation of traceability of livestock products, ensuring proper equipment, animal identification, tracking, including a system response to disease, will enable the industry to respond quickly and effectively to a variety of diseases as they occur;

- automation of traceability of crop products will track the entire life cycle of products, including the processes of production, storage, transportation, sale, destruction or disposal;

- automation of monitoring of the turnover of fish and fish products will make it possible to reduce the volume of poaching and illegal trafficking of fish products, to ensure the safety of fish resources, collection and timely processing of information on the activities of fishing and fish processing organizations and enterprises engaged in the purchase and sale of fish and fish products, its wholesale and retail sales.

Industrialized and economically stable States have developed agriculture, realizing that the degree of development of agricultural production largely depends on the level of welfare of the country. Wide application of digital technologies in the agriculture of the Republic of Kazakhstan will increase productivity, increase the contribution of agriculture to GDP, stimulate the export potential of domestic agricultural products to world markets.

The effectiveness of process management in a modern logistics system should be considered in close relationship with an integrated approach to processes and resources. In this regard, an important role should be given not only to the information and resource aspects of commodity system management, but also to the adaptation of management to changing business processes. The rational functioning of logistics systems ensures the smooth functioning of flow processes, which are the basis for the formation and development of the modern system of the world economy [7]. The key consumers of this system are individual organizations and enterprises, as well as States that flexibly and optimally use logistics processes and, as a result, gain competitive advantages at the micro–, meso– and macro levels, including foreign economic activity.

Determining the combination of different types of freight transport in individual countries depends on their location, level of development, natural and other conditions. In the transport infrastructure of most States, as a rule, all major modes of transport are involved: rail, road, air, water, pipeline. For the implementation of production and economic relations and ensuring the movement of goods through the territory of Kazakhstan, including the implementation of foreign trade obligations, mainly rail and road transport are involved, which are preferred in accordance with the estimated time and cost of transportation over a given distance, as well as the characteristics of the transported goods. When planning transportation to the destination, the exact route is developed and the possibility of tracking the movement of the cargo is provided.

Kazakhstan carries out grain transportation, mainly by rail. The volume of traffic in 2018 amounted to 283 million tons, of which 30% is accounted for exports.

The main transportation by rail in the Northern regions of Kazakhstan is carried out by JSC "Astyk TRANS", which has 15 representatives in the regions. On its basis, it is a single information portal to support IT processes, which allowed to automate the application process and ensure clear control over their execution. At the request of shippers it is also possible to provide information about the location of cars at any stage of their movement [6].

Currently, the management of JSC "Astyk TRANS" is 5 200 owned and leased grain cars. In addition, for grain transportation, it is possible to attract a cargo fleet of the Russian shareholder of the company CJSC Rusagrotrans. At the same time, priority is given to intra-Republican socially significant transportation of grain from Akmola, Kostanay, North Kazakhstan region to all regions of the country in order to ensure the stability of enterprises of grain processing and food industry, poultry and livestock.

The share of the company in the transportation of domestic grain cargoes reaches 90%, export transportation, including the countries of Central Asia, is provided by it by 50%. To increase the volume of cargo transportation and expansion of regular customers in the conditions of fierce competition of owners of rolling stock, the organization effectively uses the tools of logistics marketing. For example, at the beginning of the summer season, the company reduced the fee for the use of grain wagons for the organization of export transportation by 15%. In addition, when carrying out intra-Republican transportation, the cost of grain wagons has been unchanged for the last three years.

Other instruments aimed at tariff optimization are also used in the framework of the main activity. In particular, in 2018, an agreement was reached between JSC "Uzbekontemiryullari" and JSC "NC "KTZ" to create effective tariff conditions for the promotion of export goods through the territories of the two countries. The established agreements also apply to the transportation of grain, flour and other grain products. Also, in the conditions of the need to ensure the increase in the transportation of grain cargoes and flour products from Kazakhstan, lowering coefficients were introduced in the context of the following sections: Keles-Khojadavlet-50%; Keles-Galaba-20%. Thus, the conditions for Kazakh and Uzbek producers were actually leveled.

Despite the need to introduce an unpopular measure-an increased fee for the use of inventory cars, due to the expediency of equalizing tariff rates for this fleet in relation to their own, this made it possible for domestic carriers to compete with the owners of transport cars from other countries to generate funds and attract investment to upgrade the fleet.

After the devaluation of the tenge, the tariff for the use of cars of the inventory fleet of foreign railway administrations increased by 2 times, amounting to 3.7 million Swiss francs (1.3 billion tenge) for covered cars and grain carriers. To compensate for part of the cost of transporting grain in the railway tariff was laid 19 percent subsidy, which was carried out by the railway.

The work carried out had a positive impact on the volumes of grain and flour transportation in 2018, the value of which exceeded the indicators of the previous period by almost 1.5 times. Export operations also increased: to Iran by three times, to Uzbekistan-by 1.63 times, respectively, Afghanistan and China by 53 and 23%. In addition, in Uzbekistan, the values of flour shipment indicators grew steadily, which increased by more than 47% compared to last year.

This was largely facilitated by the introduction of a comprehensive automated system "Contractual and commercial work" (ACS DKR) in the territory of Kazakhstan. This System provides the possibility of a single entry of data on shipments in electronic form for subsequent reuse in order to track transit cargo. Currently, in the "on-line" mode, it is possible to implement the function of using a standardized reference database, with the help of which the client gets access to the tools for carrying out calculations on transport transportation on the single corporate portal of JSC "NC "KTZ".

Modern technology makes it possible not only to use rolling stock more efficiently, improve the infrastructure of railway stations, but also has a positive impact on improving the competitiveness of domestic rail transport.

At the same time, both shippers and consignees, using this system, gain confidence in the economic feasibility of organizing and performing rail transportation, the effectiveness of decisions taken in terms of ensuring the possibility of using an electronic digital signature, the development of the functional activities of transport forwarders, including tracking the arrival of cargo at the destination station. ACS DKR predicts the expansion of the list of services, including the provision of opportunities for complex works at the destination station and payment via the Internet of the full cycle of logistics costs for transportation.

It should be noted that joint activities within the framework of development of cooperation and integration of the DKR ACS used in KTZ and the current system of transport control of the Russian Railways network are designated as a promising direction. The advantage of ACS DKR is the possibility of centralization and consolidation of databases, the introduction of electronic digital signature. The work carried out jointly with the Russian operator for the introduction of electronic digital signatures, in the future can become the key to the digitalization of traffic control systems in railway transport.

Conclusion. The considered system of management of the organization of contractual and comer-cial work confirmed expediency of its use. As the main positive results shippers call convenience and efficiency in the application of the system. The transition to electronic technology has allowed to reduce the number of procedures for coordination and reduce unproductive costs, increasing the efficiency of management activities by improving the quality of the railway sector to serve the recipients and senders of goods.

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АСТЫҚ НАРЫҒЫНЫҢ ИНФРАҚҰРЫЛЫМДЫҚ ОПЕРАЦИЯЛАРЫНДАҒЫ АҚПАРАТТЫҚ ТЕХНОЛОГИЯЛАР

Аннотация. Инновациялық үдерісті дамыту бағыттары, ауыл шаруашылығын дамытудың негізгі факторларының бірі – Қазақстанда қолданылатын цифрландыру құралдарын енгізуқарастырылған. Малдардың негізгі үлесі жеке аулаларға шоғырландырылғандықтан, мал шаруашылығында алғаш рет цифрландыру белсенді енгізілгені атап өтілді, бұл ветеринарлық қауіпсіздікті ұйымдастыруда елеулі тәуекелге ие болды, кешенді ветеринарлық іс-шараларды өткізуде қиындықтар болды.Ең жақсы нәтижелілікті анықтау мақсатында технологиялардың, сұрыптардың, дақылдардың әр түрлі нұсқаларының үлкен көлемін жинауға мүмкіндік беретін AgroStrea ақпараттық жүйелерін пайдалану ұсынылған. Мемлекет алдында тұрған маңызды міндет Қазақстанға үшінші елдерден жеткізілетін және елден басқа мемлекеттерге шығарылатын өнімдердің азық-түлік қауіпсіздігін бақылауды қамтамасыз ету үшін ЕАЭО халықаралық талаптары мен нормаларын орындау болып табылады. Бұл ауыл шаруашылығы салалары мен бөлімдерінің отандық экспорттық әлеуетін іске асыруға мүмкіндік береді, өндіріс көлемін өзгертуге мүмкіндік береді, Қазақстанның ауыл шаруашылығын технологиялық дамытудың едәуір ұлғаюына ықпал етеді. «AgroStream» ЖШС-нің ақпараттық жүйелерді трансформациялау және енгізу әдіснамасын әзірлеушісі болып табылатын қызметі қаралған. «AgroStream»-«AgroMap»-мобильдік қосымшаларының АЖ жаңа модулін пайдалану агрономдардың тиімді жұмысын ұйымдастыруға мүмкіндік беретіні атап өтілген. Сандық технологияларды енгізу кезінде ауыл шаруашылығында өндірісті, қызмет көрсетуді, басқаруды және өндірісті ақпараттандыру ауыл шаруашылығы өнімдері айналымының моделін өзгертуге, өнеркәсіп парктерін және ауыл шаруашылығы өнімдерінің электрондық саудасын дамытуды ынталандыруға бағытталған. Қазіргі жағдайда классикалық экстенсивті егіншілік дәлірек ығыстырылатыны, геоақпараттық технологиялар кеңінен пайдаланылатыны, энергия үнемдейтін ауыл шаруашылығы агрегаттары енгізілгені, өсімдіктердің жоғары өнімді сорттарын селекциялау және жануарлардың жоғары өнімді тұқымдарын шығару жүргізілетіні атап өтілген. RolandBerger зерттеу агенттігінің деректері бойынша, жыл сайын Азия елдерінде әлеуетті өсімнің шамамен 20%-ы ауыл шаруашылығы саласында инновациялық технологияларды қолдану есебінен қамтамасыз етіледі. Австралияда ауылшаруашылық жануарлары мен өнімдерін сәйкестендіруге және бақылауға арналған қолданбалы жүйеге жануарлардың өмірін нақты бақылауға және барлық жануарлар мен заттарды сәйкестендіруге мүмкіндік беретін бағдарламалық модульдер жиынтығы кіреді. өмірлік циклі кезінде олармен байланыста болған, олардың өмірлік циклі ішінде байланыста болады, және бұл әртүрлі аурулардың пайда болуы кезінде жедел және тиімді әрекет етуге мүмкіндік береді. Бұл аурулардың таралуына, индустрияны қолдауға және нарықтағы операцияларды жабуға байланысты жиынтық шығындардың құнын төмендетеді. Қазақстан Республикасының ауыл шаруашылығында цифрлық технологияларды кеңінен қолдану еңбек өнімділігін арттыруға, елдің ЖІӨ-дегі ауыл шаруашылығы саласының үлесін арттыруға, отандық ауыл шаруашылығы өнімдерінің экспорттық әлеуетін әлемдік нарықтарға ынталандыруға ықпал ететін болады.

Түйін сөздер: ауыл шаруашылығы, цифрландыру, технологиялар, жүйелер, нәтижелілік, өндіріс, өнім, инновациялар,енгізу, ұйымдастыру.

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ИНФОРМАЦИОННЫЕ ТЕХНОЛОГИИ В ИНФРАСТРУКТУРНЫХ ОПЕРАЦИЯХ ЗЕРНОВОГО РЫНКА

Аннотация. Рассмотрены направления развития инновационного процесса, один из ключевых факторов развития сельского хозяйства – внедрение инструментов цифровизации, применяемые в Казахстане. Отмечено, что первоначально цифровизация активно внедрялась в животноводстве в связи с тем, что основная доля животных была сконцентрирована в частном подворье, что имело значительные риски в организации ветеринарной безопасности, сложность в проведении комплексных ветеринарных мероприятий. Представлено использование информационных систем AgroStrea, позволяющего собрать большой объем данных различных вариаций технологий, сортов, культур с целью определения наилучшей результатив-

ности. Важной задачей, стоящей перед государством является исполнение международных требований и норм ЕАЭС для обеспечения контроля пищевой безопасности продукции, доставляемой в Казахстан из третьих стран, и вывозимой из страны в другие государства.. Это позволит реализовать отечественный экспортный потенциал отраслей и сфер сфере сельского хозяйства, что позволит изменить и объем производства, будет способствовать значительному увеличению технологического развития сельского хозяйства Казахстана. Рассмотрена деятельность ТОО «AgroStream», являющееся разработчиком методологии трансформации и внедрения информационных систем. Отмечено, что использование нового модуля ИС «AgroStream» – «AgroMap» - мобильного приложения, позволит организовать эффективную работу агрономов. Информатизация производства, функционирования, управления и услуг в сельском хозяйстве при внедрении цифровых технологий нацелена на трансформацию модели оборота сельскохозяйственной продукции, стимулирование развития промышленных парков и электронной торговли сельскохозяйственной продукцией Отмечено, что классическое экстенсивное земледелие в современных условиях вытесняется точным, более широко используются геоинформационные технологии, внедряются энергосберегающие сельскохозяйственные агрегаты, производится селекция высокоурожайных сортов растений и выведение высокопродуктивных пород животных. По данным исследовательского агентства RolandBerger, ежегодно в странах Азии порядка 20% потенциального роста обеспечивается за счет применения инновационных технологий в сфере сельского хозяйства. Применяемая система идентификации и прослеживаемости сельскохозяйственных животных и продукции в Австралии включает пакет модулей программного обеспечения с возможностью точного прослеживания животных на протяжении их жизни и определения всех животных и объектов, с которыми они были в контакте в течение их жизненного цикла, что позволяет достаточно оперативно и эффективно реагировать на появление различных заболеваний уже в момент их возникновения. Это снижает стоимость совокупных затрат, связанных с распространением заболеваний, поддержкой индустрии и закрытия операций на рынке. Широкое применение цифровых технологий в сельском хозяйстве Республики Казахстан будет способствовать увеличению производительности труда, росту вклада сельскохозяйственной отрасли в ВВП страны, стимулированию экспортного потенциала отечественной сельскохозяйственной продукции на мировые рынки.

Ключевые слова: сельское хозяйство, цифровизация, технологии, системы, результативность, производство, продукция, инновации, внедрение, организация.

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ASTRAKHAN BREEDS SHEEP OF KAZAKHSTAN

Abstract. The purpose of this work is to analyze the origin and distribution of Karakul sheep in the world and the current state of astrakhan sheep breeding in Kazakhstan.

The article describes the origin of the Karakul sheep, as well as information on the creation in Kazakhstan of a new Kazakh astrakhan-fat-tail sheep of astrakhan-meat-greasy productivity. The results of a comparative study of the biological characteristics of the astrakhan breeds of sheep bred in Kazakhstan are presented.

The main products for the sake of breeding astrakhan sheep breeds are unique in their color, shades and strength of the skin.

A major breeding achievement of sheep farmers in Kazakhstan is the creation of Kazakh karakul-fat-tail sheep of astrakhan-meat-greasy productivity, which has no analogues in the world, well adapted to the desert and semi-desert zones of Central Asia and Kazakhstan.

It should be noted that the biological characteristics of astrakhan sheep breeds allow the efficient use of scarce pastures of inaccessible desert and semi-desert zones.

Key words: astrakhan breeds, karakul, Kazakh karakul-fat-tail, astrakhan-meat-greasy, pastures, desert, semi-desert, Kazakhstan, Central Asia, biological, exterior, astrakhan.

Introduction. In Kazakhstan, astrakhan breeds of sheep breeding is represented by two breeds: karakul and Kazakh karakul-fat-tail (Atyrau) astrakhan-meat-greasy productivity. It, as an industry, is a whole complex of technologically and economically interconnected primary producers (business entities with different ownership forms), enterprises that process karakul breeding products (fur enterprises, factories for primary processing of wool), a number of service enterprises and organizations.

The development of this industry is carried out on the basis of year-round grazing of sheep on natural pastures of deserts and semi-deserts, unsuitable for arable farming.

The Karakul breeding of Kazakhstan, which began with 5000 purebred sheep, the first-born of the industry, the Chimkurgan state farm, established in 1928, developed at a very high pace. This work continued during the difficult years of the war. For the period from 1951 to 1960 25 large specialized state farms were created. By the end of 1991, the number of Karakul sheep had already exceeded 6 million heads, and the production of skins reached 2 million. Karakul breeding in Kazakhstan has become one of the most important areas of the national economy of the republic [1].

The karakul breeding in Kazakhstan was created both by absorbing crossbreeding of queens of local fat-tail sheep with karakul sheep, and by importing purebred karakul livestock from farms of Uzbekistan and Turkmenistan, of which 70 thousand karakul sheep and about 250 thousand ewe lamb were imported.

The question of the origin of Karakul sheep has long attracted the attention of many researchers, therefore, there are different opinions:

1. The Karakul sheep was created in ancient times in Asia Minor and brought to Central Asia by Arab conquerors [2].

2. The Karakul sheep appeared in ancient times on the modern territory of Uzbekistan [2,3].

3. The Karakul sheep is a product of recent origin, obtained as a result of a mutation when crossed with sheep of other breeds [4].

Confirmation of the hypothesis about the antiquity of the Karakul breed and its occurrence on the modern territory of Uzbekistan can be found in the source “Geography of the East” that came to us from the Arab geographer Ibn-Haukal, a traveler who visited Khorezm in the 10th century. He wrote that he had never seen such sheep and lambs anywhere, neither in his homeland, nor in other countries and continents, and there are no such sheep in all countries as in Turkestan and the Khorezm region. The skins of these sheep have black, beautiful dark red hues and are very highly valued.

Another source indicating the credibility of the ancient origin of the Karakul breed is a portrait of Shota Rustaveli, where he is depicted in a Karakul hat - a gift from the poetess Meskhechi-Khujand (XII century).

During archaeological excavations carried out in Persopol (the capital of ancient Persia), the antiquity of which is 500 BC, utensils with the image of sheep were found, the shape of the tail and horns of which is similar to the existing Karakul sheep.

The opinion of the ancient origin of the Karakul sheep was confirmed in special literature. P.N. Kuleshov wrote: "I consider the Karakul sheep an ancient breed, the breeding of which took thousands of years of factory work." We needed a sheep with a beautiful lambskin at a young age. Centuries and millennia passed, and a wonderful Karakul breed was obtained [5].

The ancient origin of the Karakul sheep is indicated by its amazing strength of heredity, which is especially manifested when crossing with other breeds.

Academician M.F.Ivanov, noting the amazing strength of the heredity of the breed, which is especially manifested when crossing with other breeds, wrote about the ancient origin of the Karakul sheep. He noted that no matter what breed the karakul breed crosses, a half-blood offspring is always, in terms of its zoological characteristics, wool color and even quality of the lambskin is to a significant extent similar to a Karakul sheep [6].

L. Adamec believes that Karakul sheep were created in the Middle East in the second millennium BC, from where they spread to neighboring regions, including Central Asia [2].

In his opinion, the Karakul sheep descended from a very old pedigree sheep, formed in Syria, Palestine and Mesopotamia for 2000 BC, and entered Turkestan in the 8th century along with the Arabs, where astrakhan sheep breeding flourished until the Mongols conquered it, which subsequently they were almost destroyed, replacing the fat-tail sheep brought with them. And the remaining herd of Karakul sheep that survived on the remote desert pastures of the Bukhara Khanate served as valuable material for further breeding and distribution.

However, academician V.M. Yudin, an outstanding astrakhan breeder of the 40-70s of the last century, considers L. Adamec’s theory unreasonable, referring to Ibn-Haukali’s assertion that there are no sheep producing such sheep besides Central Asia beautiful lambskin. He noted that if the sheep were Arab, driven to Khorezm and Bukhara, then Ibn-Haukal, as an observing geographer, would have noted this as a person who visited India, Central Asian states, Spain, Sicily and, of course, knows his homeland well - Arabia [1].

Sh.R. Herremov and Yu.A. Yuldashbayev in the book "Karakul breeding" provides very valuable and interesting historical information on the origin of the Karakul sheep, citing literature information on karakul breeding [7].

In their opinion, the work is of great interest of the famous professor Durst, who describes the excavations in Anau near Ashgabat, which are known in zootechnical terms. These excavations, conducted under the direction of the American professor R. Pampelli (1904), are interesting in that they allowed a detailed study of the strata of the earth, the prescription of which begins from 8250 BC. In strata dating back to 6,250 BC, Durst found fossil remains of sheep that are completely similar to the existing karakul of the Maymen offspring. Therefore, Durst makes a completely solid assumption that the Karakul breed is the remains of an ancient fossil breed, called by him "Anau".

In 1861, Vamberi, a Hungarian Turkologist, succeeded the first of European researchers, secretly, under the guise of a dervish, to penetrate Bukhara and gain access to ancient manuscripts. From the Bukhara annals, he, in particular, describes the wealth of Khan Nez Magomed, who ruled the khanate since 1642, among which he mentions 80 thousand sheep who brought gray lambs.

V.M.Yudin wrote: “The zoological and biological features of the Karakul sheep allow us to conclude that this breed was created in ancient times by the peoples inhabiting Central Asia” [8].

B.N. Vasin believes that the modern Karakul sheep occurred as a result of mixing several groups of sheep, one of which was fat-tail with coarse wool, and the other of semi-coarse sheep. He (1946) emphasizes that the first references in the literature to the existence of Bukhara kuryapyaks (doodles) are found only in the second half of the 17th century. Among animals with very coarse, long wool close to that of fat-tail sheep, there are sheep with very thin, homogeneous, short wool. The live weight of the uterus ranges from 28 to 70 kg. According to the type of physique, there are sheep with a rough bone, close to the bone of fat-tail sheep and, conversely, with a very tender one. Strong variation is also observed in the shape and fat content of the tail. Even the main products of karakul breeding – astrakhan – are very diverse in their shapes, types, and sizes of curls, as well as in the character of their skin, woolline, and skin pattern [9].

I.N. Dyachkov expresses an opinion on the occurrence of the fur properties of lambs in the process of mutation of their subsequent fixing of these properties by humans by selection and selection. At the same time, he believes that the formation of the Karakul breed took place in the XVII–XVIII centuries. in the Karakul beks of Bukhara [10].

I. Ya. Averyanov believes that the initial selection was not to create smackiness in lambs at birth, but to acquire curly wool by fixing corresponding changes in the development of skin and wool in the late stages of morphogenesis [11].

It is well known that the population of Uzbekistan has long been engaged in breeding fat-tail sheep. In the 8th – 9th centuries, there appeared the astrakhan sheep of non-Karakul breed. They differed sharply from local sheep in their productivity and appearance. Merlushki obtained from such lambs were not in great demand among the population. But the wool of these sheep was significantly higher in quality than that of the local fat-tail sheep.

The sheep farmers, apparently with the aim of improving their wool qualities, began to crossbreed their local sheep with the newly imported ones. At that time astrakhan as commodity raw materials did not have much demand. As a result of prolonged selection and selection of animals in combination with suitable climatic and feed conditions, was created a completely new astrakhan breed. Lambs differed from all previously known sheep breeds in the extremely high quality of their skins in terms of curl shape, luster and wool color. The name "Karakul" a new breed of sheep received, probably, by the name of the Karakul district, located near Bukhara. The most important evidence of the creation of Karakul sheep on the territory of present-day Uzbekistan is also the fact that in the past, nowhere, in any other region of the world, lambskin had a curl so characteristic of this breed.

According to V.S. Zhilyakova and A.K. Chepelova, for many centuries, the distribution of the breed was limited to Central Asia. For the first time, Karakul sheep were exported only at the end of the 19th century: first to Ukraine, and somewhat later to the Crimea, the North Caucasus, Transcaucasia and the Middle Volga region. Since 1894, Karakul sheep from Russia (apparently meaning from Uzbekistan) were taken to Bosnia and Herzegovina (Yugoslavia), in 1903 to Germany, in 1904 to Austria. Here they took root well and gave high-quality astrakhan. Due to the lack of natural pastures, the costs of keeping sheep were high. Therefore, the herd sizes were small. But the sheep were bred clean, acquired a breeding direction with the sale of breeding animals. Subsequently, from Germany and Austria, Karakul sheep came to almost all countries of Western Europe, but due to unsuitable natural and economic conditions they were not widely spread here [12].

Then the Karakul sheep spread to Africa and Latin America. Currently, large-scale breeding of Karakul sheep is also carried out by Afghanistan and Namibia.

These materials allow us to conclude that the Karakul breed, like any other domestic animal breed, is a product of complex crossbreeding. The main criterion for long-term selection was kinkiness, which later led to the formation of curl.

In the course of scientific research, we had to carry out various variants of mating within the breed of Karakul sheep according to their colors, colors, astrakhan type, as well as fine-wool and local fat-tail meat-greasy breeds with Karakul sheep of various colors. Based on our research, we came to the conclusion that the Karakul sheep breed is a truly unique breed, transmitting its astrakhan qualities and exterior features already in the 1st and 2nd generation even when crossed with fine-wool and fat-tailed sheep. It differs from other breeds of sheep in the world, as academician M.F.Ivanov noted back in the 40s of the last century, amazing by the strength of heredity. It should be noted that only ancient breeds, such as Karakul, Edilbaev, Gissar, can transmit their pedigree distinctive features and quality indicators even at

the initial stage of crossing with other breeds, and the Karakul breed is unique in that it conveys some of its lambskin qualities in the first generation offspring [1].

In all likelihood, as most karakul breeders of the last century claim, the most important evidence of the creation of karakul sheep in Central Asia is the fact that in past times, nowhere else in any other region of the world did lamb skins possess such a curl characteristic of this breed. The antiquity of the origin of the Karakul breed is also explained by the fact that it is characterized by the exceptional strength of heredity of the astrakhan properties, which manifests itself when it is crossed with such an ancient breed as merino, and the comparative ease of converting coarse-wool breeds into astrakhan.

Karakul sheep are bred on all continents, with the exception of Australia. The widespread mass distribution of the breed was facilitated by its exceptional endurance and ability to acclimatize in a wide variety of climatic and feed conditions. So, the breeding of Karakul sheep is carried out by South-West Africa, the Republic of South Africa, Afghanistan, Iran, Uzbekistan, Kazakhstan and Turkmenistan, which are the main producers of karakul skins in the world, and a small amount is produced in Europe, North and Latin America.

It should be noted that to a certain extent, the competitor of karakul is mink. These two branches of valuable fur manufacture their products in different environmental conditions, which affected the pace of production. Thus, Karakul is produced in semi-desert and desert areas, and mink is produced in more environmentally friendly areas of the globe. Due to food security and the rapid growth of the world's population and the great demand for basic foodstuffs (mainly meat), the number of Karakul sheep in the world has been significantly reduced in the direction of increasing meat and sebaceous breeds.

Currently, a huge assortment of artificial dense materials is produced that imitate karakul fur (artificial karakul fur). They temporarily went into fashion. However, they were quickly abandoned by women who can afford to buy a fur coat made from natural karakul.

It should be noted that if the mink is famous for its luster, silkiness and colors, the karakul fur is distinguished by its beautiful pattern, curls, color and colourations, luster and silkiness. Thanks to these quality indicators, karakul is in great demand today.

The Karakul sheep breeding technology is common for sheep of other breeds: feeding, grazing, water supply, shearing, feeding, fattening, etc. At the same time, working with the Karakul breed requires not only general technical knowledge, but also knowledge of the selection features that are inherent only to sheep this breed. Breeding work in karakul breeding is similar to the work of a jeweler. It requires a specialist with great observation, aesthetic taste and understanding of the beauty of the pattern, formed by curls of different sizes, types and shapes; the ability to distinguish all the subtleties and features of the combination of colors, shades and colors of karakul. Of particular importance in this regard is the knowledge of the genetics of Karakul sheep, the inheritance of breeding and economically useful traits.

The biological characteristics of the Karakul sheep were formed in the conditions of the thinned grass stand of deserts and semi-deserts of Central Asia, where, in order to satisfy their feed requirements, the sheep have to go up to 20 km daily and use mineralized, brackish and salty drinking water.

Karakul sheep well pick small, stunted plants with their lips, pick up fallen pieces of stalks of dried grass, leaves, ears after harvesting grain.

A powerful chewing apparatus allows you to chew on coarse-stalked plants (wormwood, keireuk, saxaul branches, etc.), which are almost the only source of food on autumn-winter pastures.

Karakul sheep walk well on wormwood-ephemeral and solyanky pastures. They eat fodder plants with a bitter and tart taste with a pungent and spicy smell. Due to this feature, Karakul sheep spend much less nutrients per 1 kg of weight gain than other sheep breeds, but they do not tolerate uniform food [13].

Karakul sheep are able to lay a large amount of fat along the caudal vertebrae. In unfavorable years on pasture and fodder conditions, they compensate for the lack of pasture due to fat deposits.

Year-round pasture maintenance, sparse vegetation, lack of drinking water, sharply continental climate with sharp fluctuations in temperature and humidity not only in the seasons of the year, but also during the day, had a significant impact on the Karakul breed of sheep.

The production life of Karakul sheep is on average 6-7 years (before tooth wear), in some households sheep are used up to 8-10 years of age.

The biological maturity of Karakul sheep occurs at the age of 5-6 months, household maturity at 1,5 years of age. The fertility of ewes is an average of 93-95 lambs per 100 uterus. The highest fecundity of Karakul uterus manifests itself at the age of 4-5 years.

Kazakh Karakul-fat-tail breed of sheep (Atyrau breed astrakhan-meat-greasy productivity) bred in the period from 1974 to 1998 by a complex reproductive crossing of Kazakh-fat-tail coarse-wooled and Edilbaev uterus with coloring sura of Karakul sheep Surkhandarya and Karakalpak inbreed types, followed by breeding "in itself" crossbreeds of the second generation (authors: H.I. Ukbaev, T. Kanseitov, R.D. Shamekenova etc.).

It is the only breed bred in the Republic of Kazakhstan that combines astrakhan productivity - karakul curls, original colors, colors of the Kazakh inbreed type of suras and meat-greasy productivity with fat deposition on a fat-tail and high precocity [14].

The breed is also a source of production of high-value mutton, especially lamb and coarse wool. In addition, it provides high-quality leather-fur coat.

- the breed has no analogues in the world;

- breed of combined productivity. With changing market requirements for the production of astrakhan and mutton, you can use its valuable features - early maturity and high meat-greasy productivity or high-quality astrakhan products;

- on the exterior they are closer to the fat-tailed sheep. In lamb age they have very beautiful skins with parallel-straight and parallel concentric patterns;

- The breed is well adapted to the desert and semi-desert zones of Kazakhstan.

Biological characteristics of sheep of Kazakh karakul-fat-tail breed were formed in conditions of sparse grass stand in the arid zone of Western Kazakhstan. The breed has a huge adaptability potential to different breeding and maintenance conditions. Experience shows that the Kazakh karakul-fat-tail breed quickly and well adapts to saline desert and semi-desert zones of the Kyzylorda region, pastures of the sand zones of the Moyunkum and Kyzylkum regions, the South Kazakhstan and Zhambyl regions, without reducing the quality indicators of astrakhan productivity and live weight [14].

Sheep of the Kazakh karakul-fat-tail breed, as well as the Karakul breed, make good use of all types of pasture feeds, eat the largest number of arid pasture plants, including weeds, prickly grasses, raspberries, tersken, wormwood, etc. They make good use of the bitter plants of the semi-desert and desert zones in the autumn period of the year after rain. Sheep of the Kazakh karakul-fat-tail breed are well adapted to sparse vegetation, lack of water, a sharp fluctuation in seasonal temperatures (in winter up to -40, in summer up to +40). The period of their economic use is an average of 6-8 years, until the teeth are completely worn out, biological maturity occurs at the age of 6 months, and household maturity at 1.5 years of age. Sheep of the new breed are characterized by a harmonious physique, a strong constitution, intensive growth and development inherent in the Edilbaev sheep breed. At 1,5 years of age, in terms of live weight, they come close to the analogues of fat-tail sheep.

In terms of exterior, meat-greasy productivity and, in general, by phenotype, sheep of this breed are closer to animals of fat-tail meat-greasy breeds, and in lamb age, astrakhan productivity, and quality indicator of astrakhan to karakul sheep breed.

Lambs of the Kazakh karakul-fat-tail breed are characterized by a taut shape of a fat-tail, a deep and wide chest, a large area of lambskin, intense severity, various colors of suras, contrast and evenness of colors, pronounced silkiness and shine of the wool.

Animals of Kazakh karakul-fat-tail breed are not inferior in terms of meat-greasy productivity to Kazakh fat-tail sheep: the live weight of adult uterus is 58-66 kg, and sheep are 97-103 kg. At a lamb age, they have karakul curls of a semi-circular, ribbed and flat shape with a parallel-straight and parallel-concentric pattern of astrakhan. The wool coat is good silkiness and with a strong shine, zoning of the pigment along the length of the wool, creating a contrast in the color of the suras.

It has been established that breed precocity in karakul-meat-greasy sheep appears after birth. At birth, the lambs of this breed of different colors do not stand out in size and live weight, but in the subsequent months of the lactating period they are characterized by an intensive increase in body weight. By the time of weaning from the uterus, young ewes reach 35-39 kg, rams 40 kg or more. Possessing a sufficiently high milk content (65.0-70.0 kg), karakul-fat-tail ewes provide normal growth and development of lambs during the entire suckling period from birth to weaning without any additional feeding.

Sheep of the Kazakh karakul-fat-tail breed have a high reproductive capacity, from 120-130 lambs are born from each hundred uterus. In terms of wool shearing, Karakul-meat-greasy sheep reliably surpass sheep of mother breeds by 31.4%.

It has been established that sheep of Kazakh karakul-fat-tail breed steadily transmit their biological, productive, as well as economically useful qualities to their offspring.

In general, Kazakhstan has all the prerequisites for the development of astrakhan sheep breeding - these are unique two breeds, such as the Karakul and Kazakh Karakul-fat-tail astrakhan-meat-greasy productivity, extensive natural pasture located in desert and semi-desert territories with an area of more than 100 million hectares., personnel potential, providing scientific and technical support for the industry.

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ҚАЗАҚСТАННЫҢ ЕЛТІРІ БАҒЫТЫНДАҒЫ ҚОЙ ТҰҚЫМДАРЫ

Аннотация. Жұмыстың негізгі мақсаты – қаракөл қой тұқымының пайда болуы, оның әлемде таралуы және Қазақстанда елтірі бағыттағы қой тұқымдарының қазіргі жағдайына талдау жасау.

Мақалада қаракөл қойының шығу тарихына және Қазақстанда елтірілі – етті-құйрық майлы жаңа қой тұқымының шығарылуы жан-жақты баяндалады.

Өткен ғасырда қаракөл шаруашылығымен айналысқан ғалымдар мен мамандардың пайымдауынша қаракөл қойының Орта Азия жерінде шығуына негіз болып саналатын себеп: ол осы қой тұқымына тән қасиеттер мен белгілердің, оның ішінде елтірінің гүлінің тек осы малға ғана тән екендігінде. Ең бастысы, оның негізгі генетикалық-селекциялық белгілерінің еш өзгермей тұқым қуалағыштығы, тіпті жергілікті қылшық жүнді етті-майлы қой тұқымын қаракөл қошқарымен шағылыстырғанда онда қаракөл елтірісі белгілерінің қалыптасуы оның негізі болып саналады.

Қаракөл қойы тұқымын Орта Азия халықтары шөл және шөлейт аймақтардың қатал ауа-райымен жайылымдық жағдайында үлкен іскерлікпен сұрыптау мен жұп таңдау арқылы шығарған.

Қаракөл қой тұқымы – әлемдегі ерте заманнан келе жатқан ең әйгілі қой тұқымдарының бірі: ол жер шарында Австралиядан басқа құрлықтың бәрінде өсіріледі. Қаракөл қойын өсірумен Оңтүстік-Батыс Африка, Оңтүстік Африка республикасы, Ауғанстан, Иран, Өзбекстан, Қазақстан және Түркмения айналысады, әрі осы аталған елдер қаракөл елтірісін өндіретін ірі мемлекеттер болып саналады, ал Европа, Солтүстік және Латын Америкада аз көлемде елтірі өндіріледі.

Қазақстанда қаракөл шаруашылығымен 1928 жылы «Шымқорған» кеңшарына әкелінген 5000 бас таза қаракөл қойын өсірумен айналыса бастады, әрі осы іс-шара үлкен көлемде Ұлы отан соғысы жылдары жалғасын тапты. Тіпті 1951-1960 жылдары елімізде 25 арнайы мамандандырылған қаракөл кеңшарларға ұйымдастырылды.

1991 жылдың соңына қарай республикада қаракөл қой саны 6 млн басқа, елтірі өндіру 2 млнға жетті. Осылайша қаракөл шаруашылығы республиканың халық шаруашылығының негізгі бағыттарының бірі болып қалыптасты.

Мақалада, қаракөл қойының биологиялық ерекшеліктері Орта Азияның шөлді-шөлейтті аймағында шөбі сирек азықтық жағдайда қалыптасқаны, әрі аталған қой тұқымының азық қорегін қамтамасыз ету үшін тәулігіне 20 шақырым жайылым жерді жүретіндігі, әрі тұзды, минералды суды ішетіндігі айтылған.

Қаракөл қойларының еріндері шөбі сирек кездесетін жайылым азығын таңдай отырып, өз ағзасына қажетті керекті заттарды ала алады, тіпті жусан, кеуреуік, сексеуіл т.б. өсімдіктердіде қажетіне тиімді пайдалана алатын қой тұқымы.

Оның негізгі өнімі – қаракөл елтірісі – өзінің түр-түсінің әртүрлілігіне байланысты өте әдемі, сұранысқа ие мал өнімі.

1974-1998 жылы Атырау облысында дүние жүзінде теңдесі жоқ әрі елтірілі, әрі етті, әрі майлы өнімді жаңа қой тұқымы шығарылып, республикамыздың көптеген шаруашылықтарында өсіріле бастады.

Қазақ елтірілі-етті-майлы қой тұқымы еділбай және қазақтың қылшық жүнді құйрықты қойларының әр түрлі түстері мен реңдерін қаракөл қой тұқымының сұр түсті қарақалпақ және сұрхандариялық тұқымішілік типтің платина, антрацит, қола, янтар, өрікгүл, шамшырақгүл және болат реңді қошқарларымен екінші буданға дейін сіңіре шағылыстырылып, сол екінші будан төлдерден дене тұлғасы қазақы мен еділбай қойына сәйкес келетін, ал туылғанда өн бойындағы бұйралардың сапасы қаракөл қой тұқымының төлдеріндей көркем де әсемдікті үйлестірген сұр түсті түрлі реңді қозыларды 1,5 жастан кейін «өзімен-өзі» шағылыстырылып, ұрпағына беретіндей етіп өн бойына бекітілді.

Одан алынған төлдерді өсіру бағытында қазақы қойдың төлдері сияқты тез өсіп жетілген қозыларды іріктеп, сұрыптап тұсақ болған соң сондай өнімді аталықтармен жұптастыру арқылы саны көбейтілді.

Аталған елтірі бағытындағы қой тұқымы – әрі жоғары сапалы қой етімен бірге қозы етін шөлді-шөлейтті аймақта өндіруге бағытталған мал тұқымы.

Әрине, ең бастысы елтірілі бағыттағы қой тұқымдарының биологиялық ерекшеліктері еліміздің шөлді-шөлейтті аймағының жайылымын тиімді пайдаланылуы мақалада баяндалған.

Түйін сөздер: елтірілі қой тұқымдары, қаракөл, қазақ елтірілі-етті-майлы, жайылым, шөлді-шөлейтті, Қазақстан, Орта Азия, биологиялық, түр-келбет, қаракөл.

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СМУШКОВЫЕ ПОРОДЫ ОВЕЦ КАЗАХСТАНА

Аннотация. Цель – анализ происхождения и распространения каракульских овец в мире и современное состояние смушкового овцеводства в Казахстане.

В статье освещены вопросы происхождения каракульских овец, а также дана информация о создании в Казахстане новой казахской каракуль-курдючной породы овец смушково-мясо-сальной продуктивности. Представлены результаты сравнительного изучения биологических особенностей смушковых пород овец, разводимых на территории Казахстана.

Каракульская порода овец – одна из древнейших, приспособленных к суровым пастбищно-кормовым условиям пустынных и полупустынных регионов Средней Азии и Казахстана.

По всей вероятности, как утверждают большинство каракулеводов прошлого столетия, важнейшим доказательством создания каракульских овец на территории Средней Азии является тот факт, что в прошлые времена нигде, ни в каком другом районе мира шкурки ягнят не обладали столь характерным для данной породы завитком. Древность происхождения каракульской породы объясняется еще и тем, что ей свойственна исключительная сила наследственности смушковых свойств, которая проявляется при скрещивании с такой древней породой, как меринос, и сравнительная легкость преобразования грубошерстных пород в смушковые.

Каракульских овец разводят на всех континентах, за исключением Австралии. Широкому массовому распространению породы содействовала ее исключительная выносливость и способность акклиматизироваться в самых разнообразных климатических и кормовых условиях. Так, разведением каракульских овец занимаются Юго-Западная Африка, Южно-Африканская Республика, Афганистан, Иран, Узбекистан, Казахстан и Туркмения, которые являются основными производителями шкурок каракуля в мире, и незначительное количество производится в странах Европы, Северной и Латинской Америки.

Основная продукция, ради которой разводят смушковые породы овец – это уникальные по своей окраске, расцветке и прочности шкурки.

Каракулеводство Казахстана, начавшее свой отсчет с 5000 чистопородных овец, первенца отрасли – совхоза «Чимкурган», созданного в 1928 г., развивалось очень высокими темпами. Эта работа продолжалась и в трудные годы войны. За период с 1951 по 1960 гг. были созданы 25 крупных специализированных совхозов. К концу 1991 года численность каракульских овец уже превысила 6 млн. голов, а производство шкурок достигло 2 млн. штук. Каракулеводство Казахстана стало одним из важнейших направлений народного хозяйства республики (14).

Каракулеводство в Казахстане создавалось как путем поглотительного скрещивания маток местных курдючных овец с каракульскими баранами, так и за счет завоза чистопородного каракульского поголовья из хозяйств Узбекистана и Туркменистана, из которых было завезено 70 тыс. каракульских баранов и около 250 тыс. ярок.

Крупным селекционным достижением овцеводов Казахстана является создание казахской каракуль-курдючной породы овец смушково-мясо-сальной продуктивности, не имеющей аналогов в мире, хорошо приспособленных к пустынным и полупустынным зонам Средней Азии и Казахстана.

В статье также освещены биологические особенности каракульских овец, которые сформировались в условиях изреженного травостоя пустынь и полупустынь Средней Азии, где, чтобы удовлетворить свои потребности в корме, овцам приходится проходить ежедневно до 20 км и пользоваться минерализованной, солоноватой и соленой питьевой водой.

Следует отметить, что биологические особенности смушковых пород овец позволяют эффективно использовать скудные пастбища малодоступных пустынных и полупустынных зон.

Каракульские овцы хорошо собирают губами мелкие, низкорослые растения, подбирают опавшие кусочки стеблей высохшей травы, листочки, колосья после уборки зерновых.

Мощный жевательный аппарат позволяет пережевывать грубо- стебельчатые растения (полынь, кейреук, ветки саксаула и др.), которые на осенне-зимних пастбищах составляют почти единственный источник корма.

Ключевые слова: смушковые породы, каракульская, казахская каракуль-курдючная, смушково-мясосальная, пастбища, пустынное, полупустынное, Казахстан, Средняя Азия, биологические, экстерьер, каракуль.

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RESULTS OF TESTS ON THE STALK AND GRAIN CRUSHER OF A SMALL FODDER SHOP

Abstract. It is known that in Kazakhstan, 70 ... 80 percent of peasant farms have no more than 100 head of cattle and 500 head of sheep. To fatten these farms and to prepare a complete ration with combined feed in dairy farms, a distributer-mixer with a box with a capacity of 3 ... 5 m^3 is needed.

Since the equipment of these distributer-mixer machines with stalk and grain crushers ensures that it chops fodder itself and loads them onto a hay rye and grain warehouse of a mobile fodder shop, in the process of preparing a full ration of a combined feed, the number of operations will be reduced by 1.67 times, and the operating costs of the unit will be reduced by 1.5 times. In addition, if the stalk fodder is crushed by zootechnical requirements, i.e. 30 to 50 mm, then the uniformity of the mixing process increases. Here you can mix with the addition of nutrient feed in the preparation of the combined feed, that is, the use of a mobile fodder shop in the household allows you to carry out the process of preparing a combined feed using new and inexpensive technologies, i.e. the use of a mobile fodder shop equipped with special crushers is a technological innovation.

At present, the “Scientific Production Center of Agroengineering” on small farms is developing a mobile fodder shop for the preparation and distribution of compound feeds with a capacity of 5.0 m^3, equipped with crushers for stalk and croup. In addition, in order to simplify the drive to the crusher and to make the design simple, the crusher of the stalk and grain are equipped with one bucket, that is, this is a technical novelty of the mobile fodder shop.

Stalk and grain crushers of mobile fodder shops were made and tested. During the tests, the productivity of the stalk chopper is 2.5 ... 3.0 t/h, the power consumption is 6.2...7.0 kW, and the productivity of the grain crusher is 750 - 900 kg/h, and it was found that the power consumption in the performance range will be between 5.1 ... 7.2 kW. It was proved that the size of the crushed stalk and grain meets zootechnical requirements.

Key words: mobile fodder shop, stalk crusher, grain crusher, distributer-mixer, productivity of crushers, quality of crushed fodder.

Introduction. Currently, in Kazakhstan, 90% of cattle and 95% of sheep belong to the individual farm and the peasant farm. 70 ... 80 percent of peasant farms have no more than 50 ... 100 head of cattle and 500 head of sheep, which means that our farms are small and have fewer opportunities. That is why our farms should be equipped with appropriate universal equipment.

It is known that the development of the processes of preparation, preparation and distribution full rationale of food is associated with the development of new machines and mechanisms.

In livestock farms of leading foreign countries special distributer-mixer machines are used for mixing and distributing the complete ration of the combined feed. The leading manufacturers of these machines abroad are companies from Italy, Germany and France. For example, the Italian company AGM manufactures a distributer-mixer with a box with a capacity from 4.0 to 20.0 m^3 [1].

In the factories of Russia and the Republic of Belarus, the manufacture of machines with a box with a capacity of 6.0 ... 12.0 m^3 was released [2....7].

The problem of feed preparation was also a serious problem in the studies of foreign scientists. Their research examines the preparation of silage, the preparation of a combined feed, nutrient feed and premixes [8....13].

To optimize the parameters of the distributer-mixer, scientists are engaged in theoretical and practical research [14....16].

In addition, it was determined that when feeding livestock with a full ration of a combined feed, livestock productivity will increase by 9.0 ... 30.0%, and the feed consumption that is spent on getting 1 centner of milk will decrease by 7.0 ... 8, 0% [17].

Distributer-mixer machines in foreign countries are very expensive (16000 ... 61000 euros), and the distributer-mixer of the Republic of Belarus with a box volume of 6.0 m3, which itself has a price of more than 6.0 million.

Since our farms have about 100 head of cattle, the volume of the combined feed that is made per day is 3.0 tons, that is, this is the norm of one-day feed, which is distributed separately 3 times or 2 times. Here, the amount of combined feed of which is distributed once, in the case of distribution 3 times is 1 ton, and when 2 times it is 1.5 tons.

Since the density of the combined feed, which consists of crushed grass, silage and nutrient feed is about 340 kg/m^3 [18], for our farms the volume of the distributor-mixer box should be from 3.0 to 5.0 m^3.

At the same time, we offer technological innovations for the preparation and distribution of complete feed rations in farms, that is, equipping these small distributors-mixers with special crushers for grass and grain, which are obtained from the power take-off shaft of a driving tractor mounted on its frame. In this case, the distributor-mixer turns into a mobile fodder shop for preparing food for livestock.

The augers of many distributors-mixers are equipped with a knife, which provides their approximate grinding of stalk feed. However, grinding grass with a mixer's auger does not meet zootechnical requirements. Here the average length of the crushed stalk is 100...150 mm. If the grass is crushed to 30-50 mm in length in accordance with the zootechnical requirements, and the longest sections do not exceed 100 mm, then it is determined that when feeding cattle, its daily weight adds up to 35% [19].

In addition, mixing the grass in a mixer with a diameter of 30 to 50 mm allows the mixing process to go through high uniformity, that is, it gives the opportunity to add nutritious feed to the mixer and not require special crushers and feed aggregates for the farms, i.e., it turned out that the distributors-mixers with crushers are beneficial to farms.

Organizing large quantities of dairy and livestock farms in such small farms, the manufacture and introduction of universal equipment for the production of complete combined feed, is the main focus of the problem of livestock development and ensuring food security of the population.

Methods of research. The productivity and crushing capacity of crushers during the test was determined by agricultural machinery testing and one-factor experimental researches [20].

The results of research and their examination. On the farms a mobile small fodder shop is being developed at the Scientific Production Center of Agroengineering for the production of complete rations of combined feed (grass, silage and fodder) for livestock.

This fodder shop consists of a distributor-mixer with a volume of 5 m^3 and stalk and grain crushers installed on the same shaft. When using a foreign distributor-mixer of which is released at this time, stalk and grain are ground and delivered to the finished fodder shop, and feeding operations are performed. And the mobile fodder shop, equipped with our special crushers, goes to the place where grass accumulates, where the grass will be chopped and immediately loaded into the fodder shop box, and here the chopping of the feed is carried out by the grinder, and the it can be loaded by the crusher's deflector.

Thus, using such a mobile fodder shop, the number of operations will be reduced by 1.67 times, and the unit operating costs for the preparation of the combined feed will be reduced by 1.5 times, that is, the technological novelty of using a mobile fodder shop, the introduction of the latest experimental model of such a mobile shop is carried out as part of the project of the Ministry of Education and Science of the Republic of Kazakhstan No. AR 05131525 "reasonably make the newest experimental technology model for production and distribution feed for small farms and small mobile fodder shops" for 2018-2019.

At present, a distributor-mixer of a small fodder shop has been developed and its basic parameters are optimized [22].

To equip the mobile fodder shop with a feed crusher, the option of chopping the feed with the universal grinder DU-11 was chosen, and to simplify the drive for the crushers and the simplicity of their design, a special grinder was installed at the end of the feed crusher shaft, that is, this is a technical novelty of the mobile fodder shop (figure 1).

First of all, it was planned to make stalk and grain crushers for mobile small fodder shops, and test them.

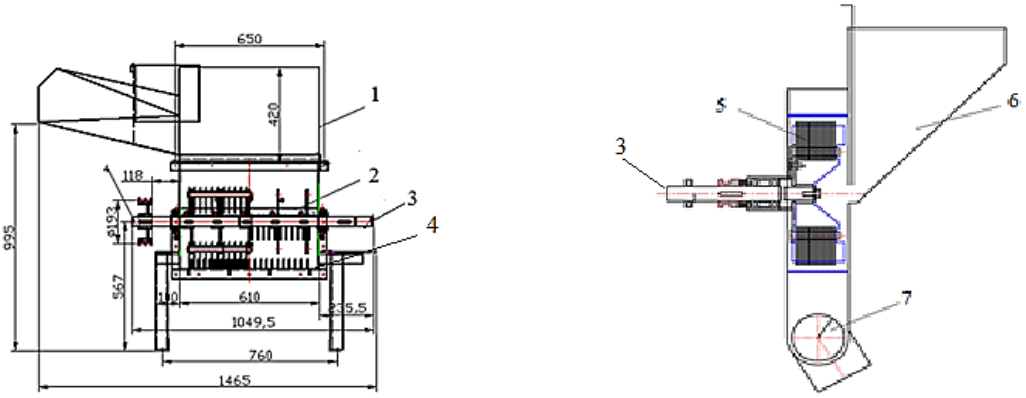

Figure 1 – Constructive-technological scheme of the stalk and grain crushers installed on a single shaft:
1 – stalk feed box, 2 – stalk chopping rotor, 3 – crusher shaft, 4 – row of fenders, 5 – grain chopping rotor,
6 – grain feed box, 7 – auger for ejection of chopped feed

During the test to measure the crusher's performance and its energy efficiency, the rotor of the crusher was put into operation by an electric motor with a power of 7.5 kW, and a belt conveyor was used in the stalk crusher for a specific performance (figure 2).

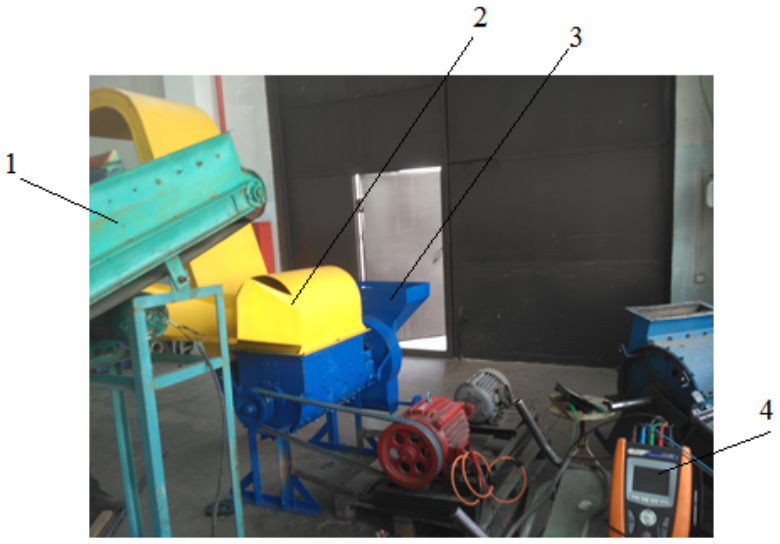

Figure 2 – Installation for testing:
1 – belt conveyor, 2 – stalk feed crusher, 3 – grain feed crusher, 4 – PQA-824 *power quality* analyzer

The productivity of grass delivery to the crusher in the experimental period was regulated by applying a known mass of grass to each meter of the distributor-mixer.

In fact, pressed grass is delivered to the crusher. Here, after receiving a string of grass from a tiny pressed grass, it is divided into parts that have a mass of from 2.0 to 2.5 kg. When these parts are delivered to the crusher, they are ground in about 3 seconds, i.e. the productivity of the crusher at this time is 2.5...3.0 t/h.

Based on the situation when the crusher operates with a productivity of 2.5 ... 3.0 t/h, it was determined that its power consumption will be 6.2 ... 7.0 kW, that is, during the test it was fully proved that crusher with such productivity works evenly and without problems.

During the test, the mass of grass with 17% humidity, with different content was crushed. For grinding grass in accordance with the zootechnical requirements, four rows of fenders were installed in the crushing chamber, i.e. the fenders in the first and second rows were set in 50 mm steps, and in 3 and 4 rows - 25 mm.

As a result of this set of fenders, chopped grass with a length of up to 30 mm was 87.22%, and chopped grass with a length of 50 mm was 93.98%, that is, larger than 50 mm with a length of 6.02%.

Zootechnical requirements for chopping stalk feed should be chopped with a length of 20...30 mm for sheep, and with a length of 30...50 mm for cattle, and the weight of grass crushed with such a length should not be less than 80% and cuts with a length of more than 50 mm should not exceed 10% [18].

It was determined that the quality of the mass fraction of ground grass by size meets the zootechnical requirements in the crusher.

Since the rotor in this grinding machine is installed at the end of the rotor for crushing the stalk feed, a box for feeding grain into the crushing chamber is installed on the chamber lid and is fed through the center of the crushing chamber.

The performance measure was changed by adjusting the measures of the feed holes in the crushing chamber using a special cover.

During the test, it was established that the productivity of the crusher with stationary power consumption in normal conditions is 750...900 kg/h, and during the work with this productivity, the power is 5.1...7.2 kW.

For grain crushing in the crushing chamber there is a strainer with holes with a diameter of 6 mm. It was determined that 85% of the crushed barley with a size of 1.0...2.6 mm; average diameter of 1.4 mm, unground grain - 0.4%.

According to zootechnical requirements, the size of crushing grain for sheep should be 1.0...1.6 mm, and for cattle - from 1.8 to 2.6 mm [18].

The size of unground grain should not exceed 0.5%. At the same time, the quality of the feed grinder and the crushing of grain feed meets the technical requirements for cattle and sheep.

In the case of housekeeping, you can adjust the size of the crushed grain in the crushing chamber using a strainer with 4.5, 6 mm holes, which means that the machine has the ability to adjust the total weight of grain supply depending on the type of livestock.

Conclusion. 1. Since 70...80 percent of the head of cattle and 500 head of sheep in our country have no more than 100, for these farms the “Scientific Production Center of Agroengineering” develops a mobile fodder shop equipped with stalk and grain crushers with bunker with a capacity of 5,0 м^3, which is intended for the distribution of the combined feed on farms.

Since this fodder shop itself goes on a hay bale and to a grain feed warehouse, and ensures that the feed is loaded into the box, shredding it, it was found that the number of operations on the preparation of the combined feed decreased by 1.67 times, and the operating expenses decreased by 1.5 times compared to distributors-mixers, not equipped with former crushers, i.e. the use of such a fodder shop is a technological innovation.

At the same time, the chopper was installed in such a way as to facilitate the drive to the chopper and simplify its design.

2. Stalk and grain crushers of mobile fodder shops were made and tested. During the tests, the productivity of the stalk chopper is 2.5...3.0 t/h, the power consumption is 6.2...7.0 kW, and it was proved that the quality of the crushed stalk and grain meets zootechnical requirements.

3. The productivity of the grain crusher is 750-900 kg/h, and it was found that the power consumption in the performance range will be between 5.1...7.2 kW, and it was proved that the size of the crushed stalk and grain meets zootechnical requirements.

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ШАҒЫН АЗЫҚ ЦЕХІНІҢ ҰСАҚТАҒЫШТАРЫНА ЖҮРГІЗІЛГЕН СЫНАҚ НӘТИЖЕЛЕРІ

Аннотация. Қазақстанда шаруа қожалықтарының 70...80 пайызында ірі қараның саны 100 бастан, ал қойдың саны 500 бастан аспайтыны белгілі. Осындай қожалықтардың бордақылау және сүт фермаларында толық рационды араласазық дайындап тарату үшін қорабының көлемі 3...5 м^3 болатын араластарғыш-таратқыштар керек.

Бұл араластырғыш-таратқыштарды сабақты және дәнді азық ұсақтағыштарымен жабдықтау жылжымалы азық цехінің шөп маясына және дәнді азық қоймасына өзі барып азықтарды ұсақтап тиеуді қамтамасыз ететін болғандықтан толық рационды араласазық дайындау процессінде операциялардың саны 1,67 есеге, ал бірлік эксплуатациялық шығын 1,5 есеге азаяды. Сонымен қатар, сабақты азық зоотехникалық талапқа сай, яғни 30...50 мм-лік ұзындықпен ұсақталған болса, онда араластыру процессінің біркелкілігі артады. Мұнда араласазық дайындағанда құнарлы құрамажем (комбикорм) қосып араластыруға болады. Шаруашылықта жылжымалы азық цехін пайдалану араласазық дайындау процессін жаңа және шығыны аз технологиямен іске асыруға мүмкіншілік береді, яғни арнаулы ұсақтағыштарымен жабдықталған мүндай жылжымалы цехті пайдалану технологиялық жаңалық.

Қазіргі уақытта «Агроинженерия ғылыми-өндірістік орталығында» шағын шаруашылықтарға қорабының көлемі 5,0 м^3 болатын, сабақты және дәнді азық ұсақтағыштарымен жабдықталған араласазық дайындауға және таратуға арналған жылжымалы азық цехі жасалу үстінде. Сонымен қатар ұсақтағыштарға жетек беруді жеңілдету және олардың құрылымының қарапайым болуы үшін сабақты және дәнді азық ұсақтағыштары бір білікке орнатылған, яғни бұл жылжымалы цехтің техникалық жаңалығы.

Жылжымалы цехтің сабақты және дәнді азық, ұсақтағыштары жасалып, оларға сынақ жіргізілді. Сынақ барысында сабақты азық ұсақтағыштың өнімділігі 2,5...3,0 т/сағ., прроцесске жұмсалатын қуат 6,2...7,0 кВт, ал дәнді азық уатқыштың өнімділігі 750...900 кг/сағ., осы өнімділікпен жұмыс істегенде жұмсалатын қуат шамасы 5,1...7,2 кВт аралығында болатыны, анықталды. Ұсақталған сабақты және дәнді азықтың ірілігі зотехникалық талапқа сай екені дәлелденді.

Түйін сөздер: жылжымалы азық цехі, сабақты азық ұсақтағышы, дәнді азық ұсақтағышы, араластырғыш-таратқыш , ұсақтағыштар өнімділігі, ұсақталған азық сапасы.

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РЕЗУЛЬТАТЫ ИСПЫТАНИЙ ИЗМЕЛЬЧИТЕЛЕЙ МИНИКОРМОЦЕХА

Аннотация. В Казахстане 70…80% крестьянских хозяйств содержат до 100 голов крупного рогатого скота и до 500 голов овец. В откормочных и молочных фермах этих хозяйств для приготовления полнорационных кормосмесей целесообразно использовать раздатчик-смеситель кормов с объемом бункера 3…5 м^3, а также снабжение раздатчика-смесителя измельчителями грубых и зерновых кормов превращает машину в передвижной миникормоцех. При этом кормоцех сам подъезжает к скирде и к складу зерновых кормов, обеспечивая измельчение и погрузку кормов в бункер кормоцеха, т.е. в процессе приготовления полнорационных кормосмесей количество операцией сокращается в 1,67 раза и снижаются удельные эксплуатационные затраты в 1,5 раза. Кроме того, измельчение стебельных кормов соответствует зоотехническим требованиями, т.е. с длиной резки 30…50 мм. Это обеспечивает повышение однородности смеси при смешивании кормов и позволяет вводить в состав кормосмеси комбикорма, т.е. использование такого передвижного кормоцеха в хозяйстве обеспечивает проведение процесса приготовления кормосмеси по новой и экономичной технологии, следовательно, данная разработка имеет технологическую новизну.

В настоящее время в «Научно-производственном центре агро-инженерии» разрабатывается передвижной кормоцех для приготовления и раздачи кормосмесей в условиях малых крестьянских хозяйств. Он состоит из бункера объемом 5,0 м^3 и измельчителей грубых и зерновых кормов. Кроме того, для облегчения передачи привода и упрощения конструкции, роторы измельчителей грубых и зерновых кормов установлены на одном валу, что является *технической новизной разработки.*

В настоящее время изготовлены измельчители грубых и зерновых кормов. Проведены их испытания. Результаты испытаний показали, что измельчитель грубых кормов имеет производительность 2,5...3,0 т/ч, а затрачиваемая мощность была в пределах 6,2...7,0 кВт. При этом также установлено, что производительность дробилки зерновых кормов была в пределах 750...900 кг/ч, а потребляемая мощность находилась в пределах 5,1...7,2 кВт. Качество измельченных грубых и зерновых кормов соответствует зоотехническим требованиям.

Ключевые слова: передвижной кормоцех, измельчитель грубых кормов, измельчитель зерновых кормов, раздатчик-смеситель кормов, производительность измельчителей кормов, качество измельченных кормов.

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CULTURE USE PROBLEMS IN SELECTION OF ISOLATED MICROSPORES IN GRAIN

Abstract. Production of haploid plants by culture of isolated microspores is a quick way of obtaining homozygous crop lines. Recessive features of mutant homozygous plants are also possible to determine by this biotechnology. Contrary from anthers culture, in which the presence of anther walls can lead to the development of diploid somatic calli and plants, the microspore culture produces only haploid or dihaploid lines. Isolated microspores culture in addition represents and has a unique identification system for studying the mechanisms of embryogenesis in *in vitro* culture. The usage of haploid technology extends the genetic basis of wheat breeding, since it allows increasing the frequency of new gene combinations. This technology significantly increases the efficiency of breeding new highly productive varieties of crops. On this basis, it becomes possible to quickly assess the prospects of dihaploids, which significantly improves the efficiency of the selection process. DH plants are completely fertile and, if necessary, may be used as parents or processed as a cultivar. DHs have been widely used for cultivar development, genetic mapping, mutagenesis, and the study of gene functions.

Key words: wheat, double haploid, haploid, microspore.

Introduction. The first haploid plant was obtained for *Datura stramonium* experimentally by A.F. Blacksie in 1922. This was the impetus for subsequent researches in the field of haploids [1]. About 50 years ago first reports of double haploids in barley (Clapham, 1973) and rice (Guha-Mukherjee, 1973) appeared [2]. However, the efficiency was so low then that these procedures could not make a significant contribution to the development of haploid technology.

Over the past fifteen years, in Kazakhstan there has been a restoration work on biotechnology, including the culture of cells and plant tissues. First of all, due to the demand for such works as the development of plant biotechnology, and, above all, the need for breeding practice of crops. It is well-established that using haploid technology hundreds of varieties of almost all economically significant crops are created [3]. In some regions of the world dihaploid varieties become dominant. For instance, in Europe 50% of cultivated barley varieties are obtained using haploid biotechnologies, while in Canada three out of five wheat varieties with the largest areas are doubled haploid varieties [4].

Obtaining haploid plants in an *in vitro* culture of male and female generative structures is one of the sought-after areas of modern biotechnology. Their main advantage is the use in breeding to reduce seven to eight sexual generations needed to stabilize the hybrid genotype. Additionally, the promise of haploids is to use the recombination variability of gametes of the first hybrid generations in practical plant breeding. On this basis, it becomes possible to quickly assess the prospects of dihaploids, which signify-cantly improves the efficiency of the selection process. Another area of use is considered dihaploids rapid stabilization of the hybrid material, which previously passed breeding selection. In this case, the dihaploid line can be a direct precursor to a variety of self-pollinating crops. Obtaining haploids from hybrids of older generations some researchers consider the most preferred way of breeding [1].

Technologies have been developed for the production of haploids in economically significant species - wheat, barley, triticale, rice, rape [5,6].

The production of haploid plants through the culture of isolated microspores is a very important tool for accelerating plant breeding [7,8]. Haploid plants derived from microspores provide the fastest way to produce homozygous and homogeneous lines of important crops. This technology therefore allows the selection of recessive mutant lines in the haploid microspore explants for their study in homozygous plants. The culture of isolated microspores is an excellent system for studying the mechanisms of microspore induction and embryogenesis, providing a platform for an ever-expanding range of molecular studies [9].

Nowadays the culture of isolated microspores is the most reliable and effective method for producing doubled haploids. Contrary from anthers culture, in which the presence of anther walls can lead to the development of diploid somatic calli and plants, the microspore culture produces only haploid or dihaploid lines. Nevertheless, there are no universal and established protocols that would allow using this method for large-scale production of doubled wheat haploids. Development of a protocol of isolated microspore culture to produce doubled haploid Kazakh wheat is based on elaborating procedures of anther stress pretreatment, microspore isolation and purification, induction of division and regeneration of haploid and dihaploid plants for Kazakh wheat. According to literature data, in order to “force” microspores to divide and subsequently obtain haploid and dihaploid plants, it is necessary to create certain conditions for their cultivation. Firstly, it was shown that microspores should be in the stage of late mononuclear or early binuclear development. Secondly, to induce the division of microspores and the further formation of colonies and nucleating structures that are able to regenerate into plants, cultures must be stressed. Precisely from the influence of extreme stressful conditions, such as cold processing of anthers, "starvation", thermal shock, that it is possible to change the genetic program of microspores as germ cells and "turn" them into somatic cells that can divide and produce fertile haploid / homozygous plants [9,10,11].

A very important point is the doubling of chromosomes in microspores. It is proved, using the example of barley, that up to 70% of microspores can, during cultivation, spontaneously double the number of chromosomes. For wheat, the percentage of spontaneous doubling of chromosomes is lower [12,13].

The processes that occur during the cultivation of microspores. Microspore or pollen embryogenesis is one of the most striking examples of plant cell totipotency [14]. The first reports of the induction of sporophytic development of microspores appeared in the second half of the 20th century [2]. Successful induction of microspore embryogenesis has been established in more than 250 plant species [15]. Nevertheless, there are still limiting factors that hinder the widespread use of haploid biotechnologies. The main ones are genotypic dependence and low frequency of plant regeneration. For many types of cereals, the most important problem of haploproduction in anther culture *in vitro* remains a high proportion of albino regenerants [1,4,13]. Given problem hinders the development of effective protocols for the production of haploid plants and doubled haploids, which reduce the time and cost of creating varieties compared to traditional breeding. Universal technologies for producing haploid plants in an *in vitro* culture of anthers (microspores) for different species do not exist, but their main stages remain unchanged. They include: growing and selecting donor plants, pretreatment of inflorescences or anthers with various stress factors, isolating anthers (microspores) and their cultivation *in vitro*, inducing embryogenesis, plant regeneration, doubling the number of chromosomes of plant regenerants. Numerous endogenous and exogenous factors influence the responsiveness of anthers in *in vitro* cultivation: conditions for growing donor plants, genotype, methods and duration of pretreatment of inflorescences or anthers, anther development stage, nutrient composition [4, 14, 15, 16]. The discovery that stress is the main signal responsible for changing the genetic program for the development of microspores and their transition to a sporophytic way of development made it possible to unite the induction model of microspore embryogenesis and optimize many technologies for producing haploid plants [17].

Gametic embryogenesis is an embryoid that has formed from a male or female gametophyte cell. When male gametes are involved, the process is called “androgenesis”, while “gynogenesis” describes the process when female gametes are used [4]. Double haploid production technologies give possibilities to create homozygotes from heterozygous plants. The development of effective haploid protocols is of great importance for breeding; their use reduces the time and cost of creating new varieties. The culture of isolated microspores is used more widely in comparison with other methods for producing haploid plants. Switching cultured *in vitro* microspores from the gametophytic to the sporophytic developmental pathway

is usually induced by various stresses applied to donor plants, inflorescences, isolated anthers, or microspores in both *in vivo* and *in vitro* conditions. Physical and chemical pretreatments (cold and heat shock, colchicine) act as triggers that induce a sporophytic pathway of development, and prevent gametophyte development of microspores. The accumulated literature data suggests that cold shock actually acts as an anti-stress factor mitigating the effect of real stress caused by starvation of anthers or microspores isolated from plants. Under the influence of stress, the microspore transforms into a depolarized and dedifferentiated cell, which is a prerequisite for reprogramming its development into an embryoid [18].

Induction of embryogenesis under stress. The term stress was proposed by Canadian physiologist Hans Selye in 1936 to describe the body's response to any strong adverse effect.

According to F. Bonet with co-authors (1998), microspore embryogenesis is an important adaptive mechanism of plants, which is found only in certain conditions as a result of stressful effects.

The switching of microspores from the gametophytic to the sporophytic developmental pathway is induced by various stresses used *in vivo* and *in vitro* [4, 19]. Regardless of the applied stress, the formation of embryogenic microspores is accompanied by the following general occasions:

1) an increase in the volume of microspores;

2) passing through DNA replication with a delay in the cell cycle;

3) autophagy of the cytoplasm;

4) the transformation of the cytoskeleton, leading to the movement of the nucleus from the peripheral to the central position;

5) the formation of a new cell wall;

6) chromatin compaction;

7) changes in gene expression [20].

Changes in gene expression can be summarized in three fundamental groups: cell responsiveness to stress; gametophyte suppression and expression of sporophytic development [21].

Thereby, stresses not only irreversibly block the gametophytic program for the development of microspores, but also switch their development to the sporophytic pathway. The discovery that stress serves as a general signal for the embryogenic development of microspores has allowed the development of a universal model for the induction of microspore embryogenesis, which includes three main stages:

- irreversible blocking of the gametophytic developmental programs in usage of stressful effects. This is a necessary, but not the only condition for the subsequent development of embryoids;

- formation of a population of embryogenic microspores due to changes at the molecular level;

- implementation of a sporophytic development program on a nutrient medium containing carbohydrates (sucrose) [18].

Applied stress on donor plants. For receiving embryogenic callus, stressful effects on donor plants in vivo are possible, while the exposure time can be different: short-term (for one stage of plant development) or long. To a large extent it depends on the impact factor, as well as on the type of plant. A local *in vitro* effect on the anther or inflorescence, on an isolated sporophytic complex is also used [20].

Widely used stresses include temperature shock, carbohydrate starvation, and colchicine exposure. The most widespread in experiments on the production of haploids in various species was the treatment of donor plants with low positive temperatures (2–4°C) for 2–7 days, and sometimes 3-4 weeks [6, 16]. "Cold processing" has become a routine haploproduction procedure in many laboratories around the world. Exposure to lower positive temperatures was used to create haploids of barley, wheat, rice, triticale, rapeseed, clementine. Shoots, inflorescences, and isolated anthers that are introduced into the culture are maintained at low temperatures [4, 19, 20]. The frequency of embryoid formation increases significantly. Cold stress is often used in combination with osmotic stress or starvation (carbohydrate or nitrogen) [22]. However, the effect of temperature on cultured anthers or microspores is not always unambiguous. For example, in Greece, in experiments with wheat varieties Acheloos and Vergina and their hybrids, was shown that cold pretreatments are not necessary for haploproduction in anther culture. The main role is played by the genotype of the donor plant and the temperature of the anther cultivation. The initiation of sporophytic development of microspores without stress was achieved in the culture of anthers of barley and wheat. These experiments indicate that isolation of inflorescences and anthers from a donor plant, as well as *in vitro* cultivation conditions, can act by themselves as stresses that, without the use of any other stresses, can reprogram the further development of microspores *in vitro* [23].

According to Sv. Zoriniants et al. with co-authorship (2005), cold shock does not act as stress, but as "anti-stress". Cold pretreatment acts as a hardening factor and induces a whole complex of cytological and physiological changes that activate the cellular defense system against other stresses. After exposure to temperature, various proteins involved in the competence of microspores, responsiveness to stress, and the induction of microspore embryogenesis were found in the triticale anther culture [18,19].

Heat shock or high temperature stress is also used *in vitro*. Elevated cultivation temperatures of wheat anthers (up to 32–34°C for four days) increase the productivity of microspore embryogenesis. Short-term exposure to high temperature stress is the most effective method of inducing microspore embryogenesis in species of the genus *Brassica* L. [8]. The positive role of using elevated temperatures has also been established in combination with other stress factors, such as starvation [22]. Heat shock causes a different spectrum of changes in the cell, in particular the induction of heat shock protein synthesis (HSPs), especially HSP70, which block the pollen differentiation program. According to the temperature differences between the growth conditions of donor plants *in vivo* and *in vitro* culturing conditions, the "more stringent" the HSP signal is. At temperatures below 25°C, HSPs do not form - temperatures are too low to show response to stress. Thus, the synthesis of HSPs can serve as a molecular marker of the reaction of microspores to stress and their ability to initiate androgenesis *in vitro* [18].

Duplicating haploid chromosome set. One of the ways of duplicating the chromosome set in haploid regenerants is to use colchicine. Colchicine is applied widely in anther and isolated microspore culture of barley, wheat, corn, triticale, and rapeseed [1, 11, 16, 24]. Adding colchicine to induction medium for wheat anther culture in 0.02 and 0.04% concentrations during first several hours of cultivation leads to asymmetric cell division due to the suppression of microtube formation and consequent increase in the number of symmetrically dividing microspores [18]. In corn anther culture, the most successful microspore embryogenesis induction was achieved in co-exposure to low positive temperatures (on donor material) and colchicine in a combination with TIBA used as growth regulator. In a study done by Tadesse, he immersed haploid plants for 4 h in a solution containing 0.2% colchicine with DMSO and few drops of Tween-20 at room temperature. After that, he washed them overnight under running tap water and replanted in pots with a mixture of soil, sand, peat and moss in 2:1:1 ratio [25,26].

Various ways of wheat chromosome doubling *in vitro* were proposed. First way is to add colchicine directly to the induction medium for anther culture in a concentration of 0.2 g/l (500 мМ). After 72 h the anthers were transferred to a colchicine-free medium. As a result, 70% of them were doubled haploids. In 1994, Ouyang with colleagues cultivated calli for regeneration in colchicine-containing medium and that resulted in yield of 54% doubled haploids (17% in control group). However, it was proven that toxicity of high colchicine concentrations decreased the number of embryoids derived from microspore culture. In addition, early chromosome doubling may lead to a possible increase in the frequency of aneuploidy in *in vitro* wheat haploids with duplicated chromosomes [27,28].

The effect of colchicine exposure on embryoid green plant formation depends on genotype [29]. Colchicine binds α- and β-heterodimers of tubulin, thereby inhibiting their further binding to microtubes, which leads to the depolymerization and movement of the nucleus from periphery to the center of the microspore. Reorganization of the cytoskeleton leads to a loss of asymmetry of the microspore and blocks gametophytic development. A connection between microtubes and cyclin-dependent kinases (Cdc2) involved in changes in cell cycle phase was also demonstrated. Cdc2 protein accumulation levels depend on cell proliferation activity. It is assumed that colchicine inhibition of spindle fiber formation may affect Cdc2 protein biosynthesis in microspores and switch to embryogenic pathway [19].

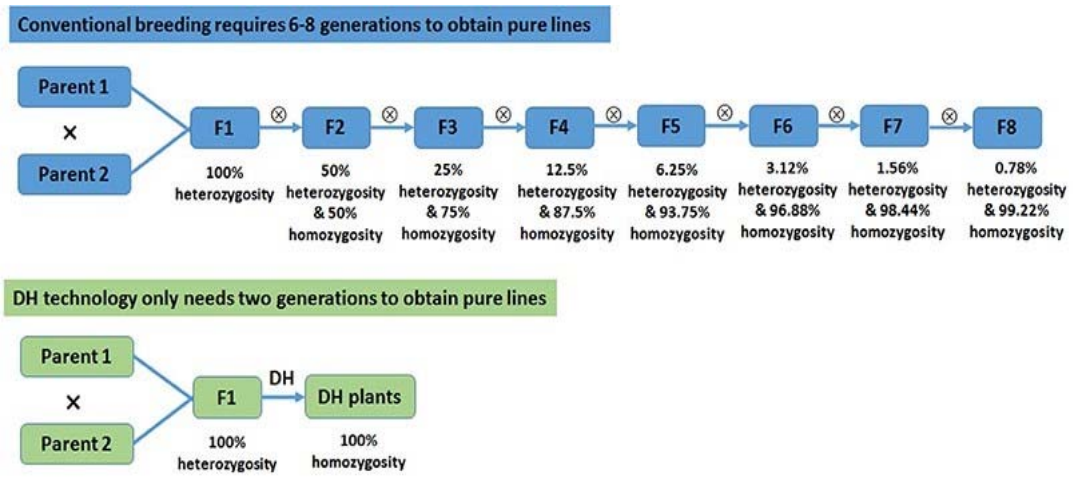
Haploid regeneration from embryoids and further chromosome duplication leads to a production of doubled haploids or DH-lines. Due to their origin, DHs are 100% homozygous, i.e. their genetic fixation may be achieved directly in F1 generation. Thus, DH production technology allows to shorten the propagation cycle (from one hybridization to the next) by several years [1].

Advantages of haploidy in cereal breeding. Using methods of doubled haploidy is the most effective way to accelerate the breeding process and obtain new homozygous forms. DH methods are based on cultivating plant reproductive tissues in order to obtain haploid plants. Using haploid technologies widens genetic diversity in wheat breeding, as long as it allows increasing the frequency of genetic combinations. This technology allows to rapidly produce homozygous lines in isolated anther and microspore culture in short period of time, which significantly reduces the amount of time required for creating new highly productive cultivars when used in breeding programs. However, many issues of

experimental haploidy are still relevant, thus limiting the practical use of doubled haploids in breeding programs and their regulation in different stages of the breeding process.

DH generates homozygous lines by doubling chromosomes of haploid plants, derived from egg-cells or sperms. There is a variety of reviews on DH technology in plants, which were improved and modified [3,15,16,22].

The main purposes in crop breeding are high harvest and quality with resistance to biotic and abiotic stresses. Crop growing programs are often based on pure lines. Traditional breeding requires 6-8 generations after crossing for getting the pure lines. From the beginning of the crossing and until the receiving of pure lines it takes 11-13 years (figure).



Comparison between conventional breeding and DH technology [30]

In figure you can see the advantage of DH technology in plant breeding. The advantage of DH technology in comparison with conventional reproduction methods is that DH achieves complete homozygosity in one generation. It allows significantly reducing the production time of pure lines. Complete homozygosity provides more precise phenotyping and gives an opportunity to precisely bind gene features in genetic mapping and studies on gene functions. They also can be used as target for studying cell biology and genetic engineering. DH technology was successfully worked out and improved many crops in which barley and rapeseed are the most responsive, and cotton and many types of legumes are much less responsive [30]. Genotype dependence, high proportion of albinism, high frequency of clones in the result of androgenesis and instability of genome, such as aneuploidy due to somaclonal variation are the main factors affecting to the efficiency of DH production [22].

DH lines are completely homozygous and contain two identical chromosome/gene set. They are ideal for evaluating quantitative trait (QT) × medium (M) interactions, whereas complete homozygosity allows better estimating of average features and allows a more accurate selection by location and year. The expected ratio in genotype segregation is 1:1 independent if a marker is dominant or co-dominant [26]. DH plants are completely fertile and, if necessary, may be used as parents or processed as a cultivar. DHs have been widely used for cultivar development, genetic mapping, mutagenesis, and the study of gene functions. However, distorted segregation coefficients may be observed, which reduces the accuracy of genetic maps. It can be caused by several reason:

1) genetic factors due to gametic or zygotic selection for pollen tube contention, preferential fertilization, chromosome translocation, etc.;

2) the dependence of DH on the genotype, that is, different reactions of cross-parents to the DH method;

3) somaclonal variations that spring up during the production of DH, leading to the production of aneuploids;

4) a high frequency of clones through androgenesis.

Long time ago it was proved that haploids are invaluable material for basic genetic research. It also can be used for quick generation of combinations of 4-fold, 5-fold, 6-fold or higher orders of multiple

mutants, obtaining homozygous maternal gametophytic lethal mutants and identifying cases of gene conversion during meiosis [18].

The first successful results of biotechnological production of doubled haploids were encouraging and offered great prospect of using cultivated crops in breeding. It was noted that the main advantage of dihaploid lines is the possibility of obtaining a homozygous line on their basis in just one generation, whereas in traditional selection several generations of inbreeding are carried out for these purposes. Therefore, the use of dihaploid lines in breeding practice can increase the efficiency and reliability of selection [1].

Conclusion. The method for obtaining haploid and dihaploid lines is associated with significant theoretical and methodological difficulties. Most successfully, the anther cultivation technique is used especially for cereals. This technology became the main one in obtaining the majority of dihaploid lines in Kazakhstan.

The production of haploid plants through the culture of isolated microspores provides the fastest way to produce homozygous and homogeneous lines of important crops. The culture of isolated microspores today is the most reliable and effective method for producing doubled haploids. In contrast to anther culture, in which the presence of anther walls can lead to the development of diploid somatic calli and plants, a microspore culture produces only haploid or dihaploid lines. At the same time, there are no universal and established protocols that would allow using this method for large-scale production of doubled wheat haploids.

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ДӘНДІ ДАҚЫЛДАР СЕЛЕКЦИЯСЫНДА ОҚШАУЛАНҒАН МИКРОСПОРАЛАР КУЛЬТУРАСЫН ҚОЛДАНУДЫҢ ПРОБЛЕМАЛАРЫ

Аннотация. Ауылшаруашылығы үшін маңызды гомозиготалы линияларды алудың жылдам әдістерінің бірі – оқшауланған микроспоралар культурасы арқылы гаплоидты өсімдіктерді алу. Сонымен қатар бұл биотехнология мутантты гомозиготалы өсімдіктердегі рецессивтік белгілерді анықтауға мүмкіндік береді. Оқшауланған тозаң культурасына қарағанда, микроспора культурасын дақылдау кезінде, тек гаплоидты және дигаплоидты линиялар шығады. Оқшауланған микроспоралар культурасы – in vitro культурасындағы эмбриогенез механизмдерін зерттеудің тамаша жүйесі. Гаплоидты технологияны қолдану бидай селекциясының генетикалық негізін кеңейтіп, жаңа гендік комбинациялардың жиілігін арттыруға мүмкіндік береді. Бұл технология ауылшаруашылық дақылдарының жоғары өнімді жаңа сорттарын өсірудегі тиімділікті арттырады.

Барлық өсімдіктерге келетін in vitro жағдайында оқшауланған микроспоралар (тозаңдар) культурасы арқылы гаплоидты өсімдіктерді алудың универсалды технологиялары жоқ, бірақ олардың негізгі сатылары өзгеріссіз қалады. Олар: донорлық өсімдіктерді өсіру және іріктеу, әртүрлі стресс факторлары арқылы гүлшоғыр мен тозаңдарды алдын ала өңдеу, тозаңдар мен микроспораларды бөліп алу және оларды in vitro жағдайында өсіру, эмбриогенез индукциясы, өсімдіктердің регенерациясы, өсімдік-регенеранттардың хромосомаларын екі есеге арттыру. Көптеген эндогендік және экзогендік факторлар тозаңдар мен микроспоралардың in vitro-да өсуіне әсер етеді. Олар: донорлық өсімдіктерді өсіру жағдайлары, генотип, гүлшоғырларды немесе тозаңдарды алдын-ала өңдеудің әдістері мен уақыты, тозаңның даму кезеңі, қоректік орта құрамы. Түрлер мен генотипке тәуелділік, альбинизмнің жоғары үлесі, андрогенезге байланысты клондардың жоғары жиілігі және сомаклоналды өзгерулерге байланысты анеуплоидия сияқты геномның тұрақсыздығы – дигаплоид (ДГ) өндірісінің тиімділігіне әсер ететін негізгі факторлар.

Эмбриогендік каллусты алу үшін донорлық өсімдіктерге in vivo жағдайында стресстік сипатта әсер етуі мүмкін, ал әсер ету уақыты әртүрлі болады: қысқа мерзімді (өсімдіктер дамуының бір кезеңінде) немесе ұзақ мерзімді. Бұл көбінесе әсер ету факторына, сондай-ақ өсімдік түріне байланысты. Сонымен қатар тозаңдарға немесе гүлшоғырға да локалды in vitro әсер етуі мүмкін. Гаплоидты технологияда кеңінен таралған стрестік әсер ету әдістерінің бірі – төменгі температурамен (2-4 °С) 2-7 күндей, кейде 3-4 аптадай өңдеу. Осы әдістің көмегімен арпа, бидай, күріш, тритикале, рапс, клементин және т.б. көптеген өсімдіктерден гаплоидттар алынды. Өскіндерді, гүлшоғырларды және оқшауланған тозаңдарды төменгі температурада өңдеу арқылы эмбриоидтардың өсу жиілігі едәуір артады. Төменгі температурада өңдеумен қоса, жылу температурамен (төрт күн ішінде 32-34 °С-қа дейін) өңдеу де микроспора эмбриогенезі өнімділігінің артуына әкеледі.

Гаплоидты регенеранттағы хромосомалардың гаплоидты жиынтығын екі есе көбейту үшін колхицин қолданылады. Ол арпа, бидай, жүгері, тритикале, рапс және т.б. оқшауланған микроспора мен тозаңдар дақылында кеңінен қолданылады.

Селекцияда басты мақсаттардың бірі – алынған өнімнің биотикалық және абиотикалық стерстерге төзімді және сапасының жоғары болуы. Ауылшаруашылық дақылдарын өсіру бағдарламалары көбінесе таза линияларға негізделген. Ал бұл таза линияларды дәстүрлі селекция арқылы алатын болсақ, будандастырудан кейін 6-8 ұрпақты қажет етеді. Яғни будандастырудан бастап, таза линияларды алу үшін ең кемінде 11–13 жыл қажет. Сондықтан ДГ технологиясының басқа дәстүрлі әдістерінен негізгі артықшылығы мынада: ДГ бір ұрпақта толық гомозиготалыққа қол жеткізеді. Бұл таза линия алу уақытын едәуір қысқартады. Толық гомозиготалық фенотипті неғұрлым дәл анықтауға және гендік карта мен ген функциясын зерттеуде гендік белгілерді дәл байланыстыруға мүмкіндік береді. Сонымен қатар оларды жасуша биологиясында және гендік инженерия зерттеу жұмыстарында нысан ретінде де қолданады. ДГ технологиясы көптеген дақылдарды жақсартты. Олардың ішінде арпа мен рапс өсімдіктерден ДГ алу оңайырақ болса, ал мақта мен бұршақ дақылдарының көптеген түрлері әлі де ДГ технологияда көптеген қиындықтар туғызады. Алынған ДГ өсімдіктері толығымен ұрпақ бере алады және қажет болған жағдайда оларды ата-ана ретінде пайдалануға немесе асылдандыру бағдарламасының бөлігі ретінде қолдануға болады. Алынған дигаплоид өсімдіктерін алуан түрлілікті дамыту, генетикалық карта жасау, мутагенез және ген функцияларын зерттеу үшін кеңінен қолданады.

Түйін сөздер: бидай, екі еселенген гаплоид, гаплоид, микроспора.

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ПРОБЛЕМЫ ИСПОЛЬЗОВАНИЯ КУЛЬТУРЫ ИЗОЛИРОВАННЫХ МИКРОСПОР В СЕЛЕКЦИИ ЗЕРНОВЫХ

Аннотация. Производство гаплоидных растений посредством культуры изолированных микроспор является быстрым способом получения гомозиготных линий сельскохозяйственных культур. Эта биотехнология позволяет также определять рецессивные признаки у мутантных гомозиготных растений. В отличие от культуры пыльников, в которых присутствие стенок пыльников может привести к развитию диплоидных соматических каллусов и растений, культура микроспор производит только гаплоидные или дигаплоидные линии. Культура изолированных микроспор является, кроме того, и отличной системой для изучения механизмов эмбриогенеза в культуре in vitro. Использование гаплоидной технологии расширяет генетическую основу селекции пшеницы, поскольку она позволяет увеличить частоту новых комбинаций генов. Эта технология значительно повышает эффективность выведения новых высокопродуктивных сортов сельскохозяйственных культур.

Универсальных технологий получения гаплоидных растений в культуре in vitro изолированных микроспор (пыльников) для разных видов не существует, однако основные их этапы остаются неизменными. Они включают: выращивание и отбор донорных растений, предобработку соцветий или пыльников различными стрессовыми факторами, выделение микроспор (пыльников) и их культивирование в условиях in vitro, индуцирование эмбриогенеза, регенерацию растений, удвоение числа хромосом растений регенерантов. На отзывчивость пыльников и микроспор при культивировании in vitro влияют многочис-ленные эндогенные и экзогенные факторы: условия выращивания донорных растений, генотип, способы и продолжительность предобработок соцветий или пыльников, стадия развития пыльника, состав питательных сред. Основными факторами, влияющими на эффективность производства ДГ, являются зависимость от видов и генотипов, высокая доля альбинизма, высокая частота клонов в результате андрогенеза и нестабильность генома, такая как анеуплоидия из-за сомаклональных вариаций.

Для получения эмбриогенного каллуса возможны стрессовые воздействия на донорные растения in vivo, при этом время воздействия может быть различным: кратковременным (на один этап развития растения) или длительным. В значительной степени это зависит от фактора воздействия, а также от вида растения. Применяется и локальное воздействие in vitro на пыльник или соцветие, на изолированный спорофитный комплекс. Наибольшее распространение в опытах по производству гаплоидов у различных видов получила обработка донорных растений пониженными положительными температурами (2–4 °С) в течение 2–7 дней, а иногда и 3–4 недель. «Холодовая обработка» стало рутинной процедурой гаплопродукции во многих лабораториях мира. Воздействие пониженными положительными температурами применялось для создания гаплоидов ячменя, пшеницы, риса, тритикале, рапса, клементина и т.д. При пониженных температурах выдерживаются побеги, соцветия и изолированные пыльники, введенные в культуру. Частота

формирования эмбриоидов существенно повышается. Холодовой стресс часто применяют в комбинации с осмотическим стрессом или голоданием (углеводным или азотным). Используется также тепловой шок или высокотемпературный стресс in vitro. Повышенные температуры культивирования пыль-ников пшеницы (до 32–34 °C в течение четырех дней) приводят к возрастанию продуктивности микро-спорового эмбриогенеза.

Для того, чтобы удвоить гаплоидный набор хромосом у гаплоидных регенерантов, используется колхицин. Он широко применяется в культуре пыльников и изолированных микроспор ячменя, пшеницы, кукурузы, тритикале, рапса и т.д.

Высокий урожай и качество с устойчивостью к биотическим и абиотическим стрессам являются основными целями в селекции культур. Программы выращивания сельскохозяйственных культур часто основаны на чистых линиях. Для получения чистых линий традиционная селекция требует 6-8 поколений после скрещивание. От начала скрещивания до получения чистых линий уходит 11–13 лет. Преимущество ДГ-технологии по сравнению с обычными методами размножения состоит в том, что ДГ достигает полной гомозиготности в одном поколении. Это позволяет значительно сократить время производства чистых линий. Полная гомозиготность позволяет более точное фенотипирование и позволяет точно связать признаки гена в исследованиях генетического картирования и функции генов. Также они могут быть использованы в качестве мишеней для изучения клеточной биологии и генной инженерии. ДГ-технология была успешно разработана и улучшила многие культуры, в которых ячмень и рапс являются одними из наиболее отзывчивых, а хлопок и многие виды бобовых являются непокорными. Растения ДГ полностью плодородны и, при необходимости, могут быть использованы в качестве родителей или выпущены в качестве сорта в рамках селекционных программ. ДГ широко использовались для развития сорта, генетического картирования, мутагенеза и изучения функций генов.

Ключевые слова: пшеница, удвоенный гаплоид, гаплоид, микроспора.

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Владимиру Игоревичу Цыганкову 60 лет

Исполняется 60 лет со дня рождения **Владимира Игоревича Цыганкова** – крупного селекционера, кандидата сельскохозяйственных наук, зав. отделом селекции и первичного семеноводства Актюбинской сельскохозяйственной опытной станции.

Владимир Игоревич Цыганков родился 16 января 1960 года в г. Актюбинске. В 1977 г. после окончания с отличием Благодарной средней школы он, по направлению от Актюбинской ГОСХОС, поступает учиться на отделение селекции и семеноводства полевых культур агрономического факультета Московской сельскохозяйственной академии им. К.А. Тимирязева. В 1982 году, окончив академию, Владимир Игоревич возвращается в Казахстан на Актюбинскую государственную сельскохозяйственную опытную станцию, в коллективе которой он трудится и по сей день.

Путь в науке он начинает в отделе селекции и первичного семеноводства станции в должности младшего научного сотрудника. В 1983 году поступает в аспирантуру Московской сельскохозяйственной академии им. К.А. Тимирязева и под научным руководством профессора Ю.Б. Коновалова в 1990 году успешно защищает кандидатскую диссертацию по специальности 06.01.05 – селекция и семеноводство. В Актюбинской СХОС В.И. Цыганков последовательно прошёл ступени роста от младшего научного сотрудника до заведующего отделом (1995 г.) и Учёного секретаря учреждения (2005 г.).

За годы своей работы и развития Актюбинской СХОС, укрепления аграрной науки в регионе, внедрения достижений науки и передового опыта в производство Владимир Игоревич проявил себя как пытливый исследователь, талантливый селекционер, умелый организатор науки и производства, инициатор многих направлений республиканского и международного творческого сотрудничества селекцентров, НИУ, вузов, других профильных учреждений и организаций РК, стран СНГ и дальнего зарубежья. Так, в настоящее время селекционеры АСХОС поддерживают и развивают творческие и производственные связи с более чем 70-ю организациями и предприятиями РК, стран СНГ, Европы, Азии, Африки, Америки.

Сферой научно-практических интересов учёного являются поисковые и прикладные исследования в области генофонда растений, биотехнологии, генетики, морфофизиологии, селекции, семеноводства, семеноведения, земледелия, растениеводства и защиты растений приоритетных зерновых, зернобобовых, крупяных и ряда кормовых культур в засушливых условиях Западного Казахстана.

Основная их направленность заключается в совершенствовании традиционных, а также в поиске и разработке новых оригинальных методов и методик для повышения эффективности практической селекции. Так, впервые в Западном Казахстане были опробованы и успешно внедрены в селекционную практику следующие результаты оригинальных исследований: метод индуцированного химического мутагенеза на сортах и гибридах яровой пшеницы и проса; метод оценки напряжённости донорно-акцепторных связей в системе «побег-колос» у яровой пшеницы и ячменя; использование экспресс-метода в оценке генотипов зерновых культур по степени их жаростойкости; прямой и косвенные методы оценки мощности развития корневой системы у приоритетных селектируемых культур как критериев их засухоустойчивости; сформирован комплекс модельных признаков (около 50 различных показателей) для новых создаваемых сортов яровой пшеницы, ячменя, проса, адаптированных к условиям сухостепных зон РК; в целях формирования региональных мозаик с использованием сортов отечественной селекции ведутся постоянные полевые опыты по разработке адаптивных элементов их сортовой технологии, а также исследования и производственные опыты в области семеноведения и оригинального семеноводства.

В результате многолетней полномасштабной селекционной работы под руководством Цыганкова В.И. и его непосредственном участии создано около 60 сортов яровой мягкой, твёрдой пшеницы, ячменя, проса, нута, переданных в разные годы в Госсортоиспытание по регионам СССР, Республики Казахстан, Российской Федерации. Из них в Госреестры селекционных достижений РК и РФ в разные годы включены 20 сортов с допуском к использованию по всем 12 земледельческим регионам Республики Казахстан и 2 Федеральным округам Российской Федерации при общей площади их посева 400-500 тыс. гектаров.

С 2011 года Цыганков В.И. является руководителем Актюбинского опорного пункта ФГБНУ «ФИЦ Всероссийский Институт генресурсов растений им. Н.И. Вавилова» (ВИР; С.-Петербург, Россия). Это позволило расширить поисковые исследования в области генофонда приоритетных для региона с.-х. культур (пшеница, ячмень, овёс, просо, кукуруза, суданка) и, как следствие – повысить эффективность практической селекции. Наряду с этим по инициативе самого юбиляра были развернуты поисково-прикладные исследования по таким культурам, как голозёрные полбоиды, нут, соя, чечевица, могар, пайза, чумиза, сорго, просо африканское, что связано с происходящими в Западном Казахстане диверсификационными процессами отраслей растениеводства и животноводства.

Результаты исследований В.И. Цыганкова по актуальным вопросам генетики, селекции, семеноводства, растениеводства, физиологии, иммунитета, агроэкологии, защиты растений опубликованы в 556 научных и научно-популярных работах, в том числе 1 монографии, 3 брошюрах, 30 научно-методических и практических рекомендациях, 5 каталогах сортовых и генетических ресурсов, нескольких программах по развитию системы семеноводства и диверсификации растениеводства Западного региона Казахстана. Более 40 его работ опубликованы на английском языке (в т.ч. 3 – в изданиях. включённых в БД Scopus) в различных странах мира – РК, РФ, Украина, Грузия, Кыргызстан, Беларусь, Латвия, Австралия, Турция, Аргентина, Италия, Великобритания; около 100 – в изданиях, рекомендованных комитетом КСОН МОН РК и ВАК РФ. Юбиляр является обладателем 32 патентов и 31 авторского свидетельства РК и РФ на селекционные достижения (яровая мягкая и твёрдая пшеница, ячмень, просо); главным редактором, спецредактором или членом редколлегий 6 изданных сборников научных трудов.

В 2003-2005 гг. являлся руководителем Международных грантовых проектов Вашингтонского Госуниверситета (WSU; USA) под эгидой CIMMYT-Mexico и фирмы «Syngenta» по внедрению новых сортов зерновых культур, агротехнологий их возделывания и средств защиты растений в фермерских хозяйствах Западного Казахстана. С 2000 года – руководитель и ответственный исполнитель научных проектов по Западному Казахстану в рамках Казахстано-Сибирской сети по улучшению яровой пшеницы (КАСИБ) под эгидой CIMMYT-Mexico, CIMMYT-Казахстан; состоял членом Республиканской комиссии по сортовидорайонированию при МСХ РК, член региональной межведомственной комиссии по аттестации и переаттестации субъектов семеноводства, входит в состав Республиканского координационного совета при Казахском НИИ земледелия и растениеводства.

Цыганков В.И. постоянно и щедро делится богатым научным и производственным опытом со специалистами и руководителями агроформирований региона, сортоиспытателями, сотрудниками

лабораторий ХПП, «КазАгрЭкс», «Фитосанитария» на многочисленных совещаниях, тренингах, курсах, «Днях поля», «Днях апробатора», полевых семинарах и выставках.

С конца 1980-х годов и по настоящее время Владимир Игоревич является преподавателем Актюбинского с.-х. колледжа, а также старшим преподавателем – доцентом (почасовиком) Актюбинского регионального госуниверситета им. К. Жубанова, Актюбинского университета им. С. Баишева, Актюбинского института повышения квалификации и переподготовки педагогических кадров, Актюбинского университета «ДУНИЕ», Казахско-Русского Международного университета (КРМУ, Актобе) – чтение обзорных лекций по проблемным вопросам биологии, экологии; проведение практических курсов, лабораторных и полевых занятий и практик по генетике, физиологии, селекции, семеноводству, растениеводству различных с.-х. культур среди студентов старших курсов, учителей биологов-экологов, преподавателей данных вузов. Под руководством Цыганкова В.И. за последние 15 лет подготовлено и успешно защищено около 25 бакалаврских работ студентами Казахского АТУ им. С. Сейфуллина, Оренбургского ГАУ (Оренбург, РФ), профильных кафедр ВУЗов г. Актобе.

Много внимания Владимир Игоревич уделяет воспитанию и просвещению молодого поколения нашей страны, выступая с лекциями и практическими занятиями перед слушателями «Назарбаев интеллектуальной школы – НИШ» из различных регионов РК; являлся руководителем и консультантом многих научных проектов учащихся средних школ, лицеев, гимназий Актюбинской области по линии Республиканского НПЦ «Дарын», Малой академии наук; ряда научных проектов молодёжи на соискание Грантов акима Актюбинской области.

Владимир Игоревич является продолжателем широко известной в Казахстане и за его пределами династии учёных-селекционеров, основателем которой был его отец – Цыганков Игорь Георгиевич (1935-2017 гг.), доктор с.-х. наук, профессор, более 60 лет проработавший в Актюбинской СХОС со дня её основания (1956 г.).

Юбиляр вместе с супругой Мариной Юрьевной, также выпускницей Московской с.-х. академии им. К.А. Тимирязева, вырастили и воспитали дочь Наталью и сына Артёма. Наталья, окончив с.-х. академию им. К.А. Тимирязева, защитила кандидатскую диссертацию по селекции озимой ржи и продолжает трудиться в Федеральном исследовательском центре «Немчиновка» (Московская обл., РФ). Зять Евгений, выпускник Брянской ГСХА, кандидат с.-х. наук, работает в АПК России, занимаясь вопросами агрохимии и улучшения плодородия почв. Сын Артём, выпускник агрофака Оренбургского ГАУ, продолжает работать в Актюбинской СХОС, перенимая научно-производственный опыт своих родителей.

За годы безупречной плодотворной работы на научном поприще и в производственной сфере Владимир Игоревич удостоен Почётной грамоты Министра сельского хозяйства РК, неоднократно награждался грамотами, дипломами, благодарственными письмами, ценными подарками от имени Акима Актюбинской области, Акима г. Актобе, а также руководства РГКП «НАЦАИ РК» МОН РК, АО «КазАгроИнновация», НАО «НАНОЦ», Международного центра CIMMYT (Mexico). В 2003 г. Цыганкову В.И. была вручена памятная медаль Московской с.-х. академии им. К.А. Тимирязева «100 лет научной селекции в России. 1903-2003 гг.».

В коллективе Актюбинской СХОС, а также среди своих коллег по творчеству и образованию, партнёров по инновационно-производственной деятельности юбиляр неизменно пользуется заслуженным авторитетом, обладает высоким профессионализмом, умеет отстаивать свою точку зрения, в быту всегда скромен.

В день славного юбилея и в год 155-летия *Alma mater* юбиляра – прославленной Тимирязевки – коллеги, партнёры, друзья, ученики искренне желают Владимиру Игоревичу крепкого здоровья, неиссякаемой энергии, счастья, благополучия и дальнейших творческих успехов в работе на благо процветания аграрной науки Казахстана.

Коллективы Актюбинской сельскохозяйственной опытной станции,
Представительства Международного селекционного центра «CIMMYT – Казахстан» (г. Нур-Султан),
Актюбинского Регионального Госуниверситета им. К. Жубанова,
ФГБНУ «Федеральный исследовательский центр Всероссийский
институт генресурсов растений им. Н.И. Вавилова» (ВИР; г. С.-Петербург, РФ),
ФГБНУ «Федеральный научный центр биологических систем и агротехнологий РАН» (г. Оренбург РФ)

МАЗМҰНЫ

Мерейтойлар

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