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B. N. Nasiyev[1], H. G. Yancheva[2], N. Zh. Zhanatalapov[1]

[1]Zhangir Khan West Kazakhstan Agricultural and Technical University,
Uralsk, Kazakhstan,
[2]Agrarian University Plovdiv, Republic of Bulgaria.
E-mail: veivit.66@mail.ru, christina@au-plovdiv.bg, Nurbolat-z86@mail.ru

CULTIVATION OF SUDAN GRASS IN DIFFERENT WAYS OF ECONOMIC USE OF WEST KAZAKHSTAN

Abstract. In increasing livestock production, a strong feed base is crucial. The supply of high-protein fodders of West Kazakhstan region is not more than 70-75% of the demand. Protein deficiency remains high in southern livestock areas. If on average 100-110 g of protein is necessary per feed unit, now there is actually 75-80 g, which leads to overexpenditure of feed by 20-25%. In the system of measures aimed at creating a solid fodder base, an important role is played by the correct selection of highly productive and environmentally plastic, adaptive fodder crops. Improving the efficiency of feed production industry is also achieved by improving technology for feed crops cultivation.Sudan grass for West Kazakhstan region is the most productive and drought-tolerant, as well as potential culture. In this regard, it is relevant to carry out studies to improve the technology for the cultivation of Sudan grass for the production of fodder raw materials for livestock production.The aim of the research is to study the technology of cultivation of Sudan grass to provide livestock production with full feed. As a result of the conducted researches, data on efficiency and fodder value of Sudan grass in the conditions of West Kazakhstan region at cultivation for green forage, hay and haylage were obtained by means of selection of optimum term of harvesting. In total for 2 hay cutting, Sudan grass provides collection of 130.75 c/ha green mass for use as livestock feed, 131.92 c/ha green mass for production of haylage and 33.83 c/ha of dry hay.

Key words: Sudan grass, harvesting time, green feed, hay, haylage, yield, feed value.

Introduction. Head of State N.A. Nazarbayev in his message to the people of Kazakhstan "Third Modernization of Kazakhstan: Global Competitiveness" noted that the agricultural sector should become a new driver of the economy. An important factor in increasing the efficiency of crop diversification in Kazakhstan and reducing the dependence of crop productivity on weather conditions, as well as ensuring food security, is the expansion of crops that are most adapted to unstable plant moisture [1-4].

A successful solution to the problem of creating a solid feed base depends on the efficiency of both meadow and field feed production. Increasing the productivity of field feed production is primarily determined by the optimal combination of the most productive and valuable field feed crops. One-year-old feed crops play a major role in solving the problem of green animal feed supply. Their cultivation in the green conveyor system makes it possible to obtain fodder during the most tense periods when other sources are absent, or cultures have not reached hay cutting ripeness.

A large number of scientists in various countries have worked and are working on the issues of creating a sustainable feed base.

Sudan grass (Sordhum sudanense (Piper) Stapf) grows in wild condition in Sudan. Over time, introduction to the United States from Egypt (at the beginning of the last century), Sudan grass captured a huge range. It was brought to Europe by Russian scientist V.V. Talanov in 1914 and by the 1950s from the south of the European part of Russia advanced north and east to the line Polotsk - Moscow - Chelyabinsk - Novosibirsk - Far East, occupying more than 2 million hectares [5].

Among one-year fodder crops, Sudan grass is one of the first to be cultivated in almost all the farming areas of our country. This widespread culture is due to its high yield, good feeding qualities and biological properties.

Sudan grass is suitable for green mass use, for preparation of hay, senage, haylage, grass flour, for production of grain. This versatile application is combined with ecological plasticity of Sudan grass, which allows it to be grown on almost all types of soil [6]. This culture is characterized by high drought resistance, well uses precipitation of the second half of summer, due to which it forms a large above-ground mass. Sudan grass is characterized by good recovery ability, bushiness, in daily growth exceeds such culture as corn, and good recovery ability allows to obtain 3-4 hay cuttings. Nutrient content in plants depends on soil properties and type, variety, agricultural level, organogenesis stage, weather conditions and other factors [7]. In terms of nutrition it also occupies one of the leading places. 1 kg of green mass contains 0.22 fodder units and up to 20 grams of digested protein. In terms of nutrient content, Sudan grass is superior to many other cereal herbs and contains less fiber [8]. Improving feed quality is no less important than increasing yield. Priority should be given to studying chemical composition of green mass, as the quality of hay, silage and haylage is influenced by the technology of their harvesting and storage. At the same time, it is advisable to determine the level of change of chemical composition depending on agricultural and environmental conditions on a regional scale. In the vast majority of cereals and legumes, protein content of green mass solids decreases as the growth and development phases pass, while the yield of green and dry mass increases [9]. Therefore, according to some scientists, it is recommended to harvest Sudan grass for green feed and hay in booting phase [10]; according to others - in the phase of ear formation [11].

It should also be considered that the time of the first hay cutting has a significant effect on the harvest value. When mowing in booting phase, the first hay cutting is lower than to ear emergence phase, but the largest harvest is formed. Kolomiets N.L., Gorpinichenko S.I., Yermolina G.M. (1999) recommend taking into account grade features of Sudan grass when choosing harvesting terms, noting that Sudan grass needs to be harvested before ear formation, or at its beginning [12].

The issues of grade crops use for the production of full-value fodders were also reflected in the works of scientists from far abroad [13-15]. According to the summary, studies carried out with Sudan grass in different countries are focused on other quantities of soil, climate, levels of plant productivity and profitability of agricultural production. Previously, no similar studies under the proposed scheme have been carried out under the conditions of the research area.

Research methods. The research is carried out on the experimental field of Zhangir Khan West Kazakhstan Agricultural and Technical University. (the Republic of Kazakhstan, Uralsk). The work is carried out within the framework of the grant financing program of the Science Committee of the Ministry of Science of Kazakhstan on the project AP05130172 "Development of adaptive technologies for the cultivation of fodder and oilseeds in relation to the conditions of West Kazakhstan" and on the topic of PhD "Formation of Sudan grass harvest in fodder lands of West Kazakhstan region".

By morphological characteristics of profile genetic horizons and agrochemical indicators of arable layer, the test area soil is characteristic for dry steppe zone of West Kazakhstan.

The area of plots is 50 m^2; the repetition is three-fold; the plots location is accidental. Agricultural machinery of Sudan grass cultivation accepted for zone 1 of West Kazakhstan region. The test uses Brodskaya 2 zoned variety of Sudan grass. During field tests, accounting, observation of the beginning of phenological phases and growth of Sudan grass were carried out according to generally accepted methods [16]. Photosynthetic activities of Sudan grass crops were studied according to generally accepted method [17]. Identification of major photosynthetic indicators for the development phases of Sudan grass. The area of one leaf was calculated by Anikeeva-Kutuzov formula. Harvesting and registration of crops by continuous method with subsequent reduction to standard humidity. Statistical processing of research results by dispersion method, analysis using computer programs [18].

Results and discussion. One of the distinctive properties of Sudan grass is its high recovery ability, which allows after removal of the main hay cutting to obtain an additional full hay cutting of green mass. At the same time, the intensity, i.e. vegetative renewal capacity of Sudan grass after mowing, magnitude of total crop, distribution of it by hay cuttings and feed quality depends on mowing terms. The terms of Sudan grass mowing have been studied by many scientists and all scientists treat the optimal terms of

Sudan grass mowing differently. For example, M.S. Trusov (1935) recommends the use of Sudan grass for feed from the beginning of ear emergence to the blooming period [19].

According to M.P. Elsukov, A.P. Movsisyants (1950) the best harvesting period is the beginning of ear appearance [20]. The recovery ability of Sudan grass depends primarily on the degree of bushiness activity, daily increase and length of the period between hay cuttings. In this regard, we have studied the main elements that determine the excesses, such as the number of shoots on plants (bushiness) and the thickness of stems in the lower intersections.

The research shows that mowing terms have a direct impact on bushiness indicators. Thus, when harvesting before ear formation, bushiness capacity of Sudan grass was 3.8. When harvesting at the beginning of ear formation, the number of Sudan grass shoots is 3.9 pieces per plant. With further extension of the harvesting period to the blooming period, the number of Sudan grass shoots increased to 4.0 per 1 plant. At the same time, at early harvesting for green fodder there was a decrease in the thickness of inter-node of stems 4.0 mm (before ear formation). When harvesting for hay at the beginning of Sudan grass ear formation, the thickness of the inter-node of the stems was 4.1 mm, and when harvesting in the blooming period for hay this indicator is 4.2 mm.

According to crop structure analysis data, harvesting times have a significant impact on the appearance of Sudan grass, which, as the most valuable part of the crop, determines the quality of the produce (protein and other nutritional components of the crop). In 2018 studies, when harvesting Sudan grass before ear formation, the share of leaves in the structure of the total harvest was 44.15%. With the postponement of the harvesting period to the beginning of Sudan grass ear formation, there was a decrease in the specific weight of leaves in the crop structure to 40.05%. A further decrease in the number of leaves in the crop structure was observed when harvesting hay cutting mass in the blooming period of Sudan grass. In this variant, the share of leaves in the total crop structure was 27.91%.

According to studies, the productivity of Sudan grass depends on the terms of mowing of hay cutting mass. In 2019 studies, when harvesting Sudan grass before ear formation, the yields of green and dry mass were 78.25 and 17.00 c/ha, respectively. The postponement of the harvesting period to the beginning of Sudan grass ear formation ensured the collection of green mass at 85.12 c/ha and dry mass at 19.17 c/ha.

When harvesting hay cutting mass for hay in the blooming period, the harvest of green mass and dry crop of Sudan grass increased to 99.14 and 23.94 c/ha, respectively. In this version, compared to earlier harvesting terms, the collection of green and dry mass of crops is more by 14.02-20.89 and 4.77-6.94 c/ha. This is the best option for the productivity of Sudan grass. The increase in productivity of Sudan grass in the blooming phase is due to the growth of leaf and vegetative mass compared to the earlier phases of vegetation.

In terms of the collection of feed units, the digested protein, the productivity of Sudan grass in 1 hay cutting was high when harvested for hay at blooming phase (19.16 and 1.61 c/ha). The lower yield of feed units and digested protein from 1 hectare compared to the harvesting at blooming phase was on Sudan grass harvesting for haylage in the start phase and for green feed before ear formation (3.38-4.31 and 0.07-0.03 c/ha). When harvesting before ear formation, the productivity of Sudan grass on the yield of feed units compared to harvesting in the phases of beginning of ear formation and blooming was lower by 0.93-4.31 c/ha. In ear formation harvesting, there was a slight increase in the yield of digested protein (1.58 c/ha) compared to harvesting for hay in the initial ear formation phase (1.54 c/ha), due to the decrease in protein digestion. A relatively high level of supply of feed units with protein is noted at the option of harvesting Sudan grass for green feed before ear formation (106 g). This indicator in other variants of harvesting for hay and haylage decreased to 84-98 g, respectively. In all 3 test sites, relatively higher exchange energy was detected in the version of harvesting Sudan grass for hay in the blooming phase - 23.43 GJ/ha. Exchange energy yield on other variants was 17.59-19.15 GJ/ha.

In the studies in 2019, single-species crops of Sudan grass were assessed on the harvest of after-grass. The inter-cutting period of Sudan grass depends on the timing of the first cutting. The length of the growing period of Sudan grass during harvesting at the beginning of ear formation was 49 days, during the ear formation period 49 days and during the blooming period 58 days. The duration of inter-cutting period (from harvesting of 1 cutting to harvesting of 1 after-grass or 2 cutting) in the first variant (at the

beginning of ear formation) was 30 days, in the second variant (before ear formation) 28 days and in the blooming period 35 days.

In the second cutting, due to the reduced vegetation period, the height of Sudan grass plants was lower than that of the first cutting plants. In the second cutting, the trend on growth also remains that is noted in the first cutting; with the extension of harvesting term, decrease in height of plants from 52.82 cm (the beginning of ear formation) to 45.45 cm was noted (bloomin).

As the data of biometric measurements of 2019 show, in 2 cutting compared to 1 cutting there was a decrease in the appearance of Sudan grass plants. At the same time, the decency of after-grass leaf formation also depended on the timing of Sudan grass mowing in 1 cutting or on the duration of te inter-cutting period. In the experiments there was a decrease in leaf formation from 49.20 to 32.25% when harvesting Sudan grass in 1 cutting from the phase before ear formation to blooming phase. There has been an increase in bushiness of Sudan grass in 2 cutting. The number of sprouts of Sudan grass depending on the time of harvesting in 1 cutting was 4.2-4.3 pcs/plant. At the same time more bushy plants were determined in early harvesting of Sudan grass in 1 cutting.

The reduction of inter-cutting period from 35 to 28 days also had an impact on the conservation of Sudan grass plants. When harvesting Sudan grass (2 cutting) on crops, the thickness of plant standing was 118 pcs/m2 (before ear formation), 112 pcs/m2 (beginning of ear formation) and 109 pcs/m2 (beginning of blooming). At inter-cutting period of 28 days, the safety of crops amounted to 84.28%, at the reduction of inter-cutting period to 30 days, the safety was at the level of 80.0%. The lowest safety of crops - 77.86% was observed when harvesting Sudan grass in 1 cutting in blooming phase (inter-cutting period 35 days).

The productivity of Sudan grass after-grass in turn also depended on the harvesting time of 1 cutting. At the same time, the highest collection of both green and dry mass was high when harvesting 1 cutting before ear formation of Sudan grass - 52.50 and 12.43 c/ha. Compared to 1 harvesting period when harvesting Sudan grass at the beginning of ear formation and in blooming phase, the productivity of green and dry mass collection in comparison with 1 harvesting period was lower by 4.25-8.55 and 1.702.54 c/ha respectively (table).

In cutting 2 by feed and energy benefits, the advantage was also given to the 1 harvesting time of 1 cutting, i.e. harvesting of Sudan grass before ear formation - 10.82 c/ha feed units, 0.99 c/ha digested protein and HJ/ha exchange energy 12.87. The minimum collection of feed units (8.61 c/ha), digested protein (0.63 c/ha) and exchange energy (10.23 GJ/ha) was obtained at 3 harvesting times of 1 cutting, i.e. in blooming phase of Sudan grass for hay. The intermediate position according to energy-protein assessment is occupied by the option of harvesting Sudan grass in the phase of ear formation beginning of Sudan grass for haylage. Here, the yield of feed units from Sudan grass was 10.09 c/ha, the digested protein was 0.83 c/ha and the exchange energy was collected at 12.03 GJ/ha.

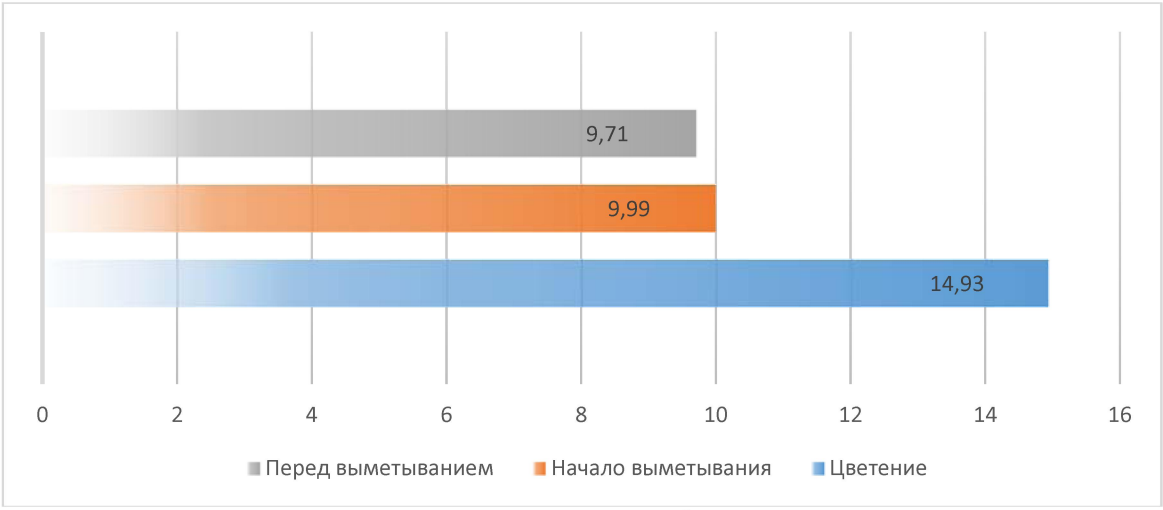
Total productivity of Sudan grass for 2 hay cuttings depending on mowing time in 2009, c/ha

Indicators	Harvesting terms		
	before ear formation	at the beginning of ear formation	blooming
Green mass, c/ha	130.75	131.92	137.39
Dry mass, c/ha	29.43	30.76	33.83
Feed units, c/ha	25.67	25.87	27.77
Digested protein, c/ha	2.57	3.37	2.24
Exchange energy, GJ/ha	30.46	31.18	33.66
LSD_{05} – 1.00-1.62 c/ha			

As can be seen from the data in Table 1, the total productivity of Sudan green grass single crops for 2 hay cuttings was approximately equal to 130.75; 131.92 and 137.39 c/ha. There was a slight difference between harvesting time for dry matter collection and feed units. At the same time the highest collection of dry mass and fodder units was determined during harvesting of Sudan grass in the blooming phase - 33.83 and 27.77 c/ha.

By the yield of digested protein, the advantage over 2 variants of the harvesting period was at hay cutting time of Sudan grass in the phase of ear formation beginning, which is due to the increased protein content and increased forage of the feed to earlier phases of vegetation. By the output of exchange energy, the option of harvesting Sudan grass in the blooming phase has a difference. Here 33.66 GJ/ha of exchange energy was collected in total for 2 hay cuttings, which is more by 2.48 GJ/ha (ear formation beginning) - 3.20 GJ/ha (before ear formation) compared to the rest of the harvesting period.

Depending on this, leaf surface area is differently formed. The data of our studies on the measurement of photosynthetic potential in single-species crops of Sudan grass are given in figure.



Leaves area, thousand m^2/ha

Photosynthetic activity of Sudan grass depending on harvesting time

The productivity of any culture is formed not only by powerful vegetative mass, but also by morphobiological feature of the structure of individual organs. Depending on this, leaf surface area is differently formed.

In the studies, the largest area of leaves was at Sudan grass harvested in the blooming period - 14.93 thousand m^2/ha. At the harvesting in phase before ear formation for green fodder the area of Sudan grass leaves was 9.71 thousand m^2/ha. The delay in the harvesting period until the start of ear formation (for haylage) provided Sudan grass with a leaf surface area of 9.99 thousand m^2/ha.

Conclusion. In the arid conditions of West Kazakhstan, Sudan grass is one of the highly productive and technologically versatile crops for the production of green mass, for the harvesting of hay, haylage and silage. The productivity of Sudan grass depends on the mowing terms of hay cutting mass.

In West Kazakhstan region the most effective term is the harvesting of hay cutting mass in the blooming phase. In the studies carried out when harvesting Sudan grass for hay in the blooming phase, the harvest of green mass and dry harvest of Sudan grass increased to 79.25 and 19.66 c/ha, respectively. In this version, compared to earlier harvesting terms, the collection of green and dry mass of crops is more by 6.26-16.08 and 1.91-5.98 c/ha. In terms of the collection of feed units, the digested protein, the productivity of Sudan grass in 1 hay cutting was high when harvested at blooming phase (15.25 and 1.30 c/ha). When harvested in the blooming phase, the collection of exchange energy by Sudan grass crops was at 18.65 GJ/ha.

The studies have determined the highest total productivity of agrophytocenoses of Sudan grass taking into account after-grass (2nd hay cutting) during harvesting in the blooming phase: collection of dry mass and fodder units - 24.93 and 19.83 c/ha.

Б. Н. Насиев[1], Х. Г. Янчева[2], Н. Ж. Жанаталапов[1]

[1]Жәңгір хан атындағы Батыс Қазақстан аграрлық-техникалық университеті, Орал, Қазақстан,
[2]Пловдив аграрлық университеті, Болгария Республикасы

БАТЫС ҚАЗАҚСТАНДА СУДАН ШӨБІН ӘР ТҮРЛІ ШАРУАШЫЛЫҚ МАҚСАТТА ПАЙДАЛАНУ ҮШІН ӨСІРУ

Аннотация. Мал шаруашылығы өнімдерін өндіруді ұлғайту кезінде шешуші рөл тұрақты жемшөп базасын құруға тиесілі. Батыс Қазақстан облысында мал шаруашылығының ақуызы мол мал азымен қамтылуы 70-75%-дан аспайды. Әсіресе ақуыңздың жоғары деңгейде жетіспеушілігі оңтүстік аудандарда жоғары болып отыр. Егер жемшөптің бірлігінде орташа есеппен 100-110 г ақуыз болуы шарт болса, қазіргі уақытта бұл көрсеткіш 75-80 г деңгейінде, бұл жем-шөп қорын 20-25% -ға артық пайдалануға әкеледі. Тұрақты жемшөп базасын құруға бағытталған шаралар жүйесінде жоғары өнімді және экологиялық таза, бейімделген жемшөп дақылдарын дұрыс таңдау маңызды рөл атқарады. Жемшөп өндірісінің тиімділігін арттыруға жемшөп дақылдарын өсіру технологиясын жетілдіру арқылы қол жеткізіледі. Батыс Қазақстан облысы үшін судан шөбі ең өнімді және құрғақшылыққа төзімді, сонымен қатар перспективалы дақыл болып табылады. Осыған байланысты мал азығына арналған шикізат өндіру үшін судан шөбін өсіру технологиясын жетілдіру бойынша зерттеулер жүргізу қажет.

Зерттеудің мақсаты – ауыл шаруашылығы малдарын толық жемшөппен қамтамасыз ету үшін судан шөбінің өсіру технологиясын зерттеу. Зерттеулердің нәтижесінде Батыс Қазақстан облысы жағдайында судан шөбінің ору мезгілін реттеу арқылы жасыл балауса, пішендеме және құрғақ шөпке орылатын бұл дақылдың өнімділігі мен мал азықтық құндылығы туралы мәліметтер алынды. Жалпы алғанда, 2 шөп ору мерзімі бойынша судан шөбі малға устеме қоректендіруге пайдаланылатын 130,75 кг/га жасыл балауса, пішендеме дайындауға қажетті 131,92 кг/га жасыл масса және 33,83 кг/га құрғақ шөп жинауды қамтамасыз етті.

Түйін сөздер: судан шөбі, ору мерзімі, жасыл жем, құрғақ шөп, пішендеме, өнімділік, мал азықтық құндылық.

Б. Н. Насиев[1], Х. Г. Янчева[2], Н. Ж. Жанаталапов[1]

[1]Западно-Казахстанский аграрно-технический университет им. Жангир хана, Уральск, Казахстан,
[2]Пловдивский аграрный университет, Республика Болгария

ВОЗДЕЛЫВАНИЕ СУДАНСКОЙ ТРАВЫ ПРИ РАЗЛИЧНЫХ СПОСОБАХ ХОЗЯЙСТВЕННОГО ИСПОЛЬЗОВАНИЯ В ЗАПАДНОМ КАЗАХСТАНЕ

Аннотация. В увеличении производства продуктов животноводства решающая роль принадлежит созданию прочной кормовой базы. Обеспеченность высокобелковыми кормами Западно-Казахстанской области составляет не более 70-75% от потребности. Остается высоким дефицит белка в южных животноводческих районах. Если в среднем на каждую кормову единицу необходимо иметь 100-110 г протеина, то сейчас фактически приходится 75-80 г, что приводит к перерасходу кормов на 20-25%. В системе мер, направленных на создание прочной кормовой базы важная роль принадлежит правильному подбору высокопродуктивных и экологически пластичных, адаптивных кормовых культур. Повышение эффективности отрасли кормопроизводства достигается также за счет совершенствования технологии возделывания кормовых культур.

Суданская трава для Западно-Казахстанской области является наиболее продуктивной и засухоустойчивой, а также перспективной культурой. В связи с этим, актуальным является проведение исследований по совершенствованию технологии возделвания суданской травы для производства кормового сырья животноводству.

Целью исследований является изучение технологии возделывания суданской травы для обеспечения животноводства полноценными кормами. В результате проведенных исследований получены данные по продуктивности и кормовой ценности суданской травы в условиях Западно-Казахстанской области при возделывании на зеленый корм, на сено, на сенаж посредством подбора оптимального срока уборки. В сумме за 2 укоса суданская трава обеспечивает сбор 130,75 ц/га зеленой массы для использования в качестве подкорма скоту, 131,92 ц/га зеленой массы для производство сенажа и 33,83 ц/га сухого сена.

Ключевые слова: суданская трава, срок уборки, зеленый корм, сено, сенаж, урожайность, кормовая ценность

Information about authors:

Nasiyev B. N., Doctor of agricultural sciences, Corresponding member of NAS RK, Professor of Higher School "Technology of crop production" West Kazakhstan agrarian-technical university named after Zhangir khan, Uralsk, Kazakhstan; veivit.66@mail.ru; https://orcid.org/0000-0002-3670-8444

Yancheva H. G., Professor, Doctor PhD, Agrarian University Plovdiv, Republic of Bulgaria; christina@au-plovdiv.bg; https://orcid.org/0000-0002-2392-915x

Zhanatalapov N. Zh., PhD Doctoral Student West Kazakhstan agrarian-technical university named after Zhangir khan, Uralsk, Kazakhstan; Nurbolat-z86@mail.ru

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