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РЕЗЮМЕ

Изучали особенности накопления пластидных пигментов листовым аппаратом облепихи крушиновидной (*Hippophae rhamnoides* L.) в природных популяциях юго-востока Казахстана на территории государственного национального природного парка «Көлсай көлдері». Актуальность работы определена высокой потребностью в обеспечении населения Республики Казахстан и Российской Федерации витаминной и лекарственной продукцией, получаемой из плодов облепихи и широкими перспективами её селекционного совершенствования. Объектами исследований явились три популяции указанного вида, расположенные на разной высоте над уровнем моря в пойме реки Шелек. Методология работы предусматривала реализацию принципа единственного различия и соблюдение базовых требований к организации опыта: типичности, пригодности, целесообразности и оптимальности. Натурные обследования лесных участков на территории Казахстана проведены полевым экспедиционным методом в 2023 году. Камеральный этап выполнен в лаборатории лесной селекции Нижегородского ГАТУ. Предметом исследований выступала специфика содержания и соотношения фотосинтетических пигментов в листьях растений, представлявших разные популяции облепихи в зоне исследования. Реализован спектрофотометрический метод определения содержания хлорофилла-*a*, хлорофилла-*b* и каротиноидов. Использован спектрофотометр СФ-2000 с программным обеспечением GRASS GIS 7.6.1 / QGIS 3.4. Установлена неоднородность пигментного состава листьев сравниваемых между собой растений, проявившаяся в форме индивидуальной фенотипической изменчивости и межпопуляционных различий. Выявлена слабая дифференциация популяций в указанном аспекте. Наибольшее содержание хлорофилла-*a* (0,92±0,009 мг/г), отмеченное на втором опытном участке, превысило соответствующие величины первого (0,90±0,005 мг/г) и третьего (0,90±0,004 мг/г) участка только на 0,02 мг/г или в 1,022 раза. Различия в пигментации листьев мужских и женских особей выражены столь же мало, что наблюдалось повсеместно.

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CULTIVATION TECHNOLOGY AND PRODUCTIVITY OF SWEET SORGUM IN THE CONDITIONS OF SOUTH KAZAKHSTAN

ANNOTATION

The article presents research data on sweet sorghum with yield indicators, a heat-resistant, drought-resistant crop in the conditions of Southern Kazakhstan. Sorghum has a wide range of uses and is ranked third in the world as a food plant after wheat and rice. Grain is a valuable feed for livestock and a raw material for the feed, starch, syrup and alcohol industries; It is used as a grain crop in the preparation of cereals and bread. External conditions have both direct and indirect effects on economic growth. It is known that the rate of growth and development of plants depends on the intensity of physiological, metabolic and energy processes, air and root nutrition, moisture exchange, and when they change, the influence of external conditions can affect the growth rate. It should be noted that in natural conditions it is quite difficult to establish which of the factors may have an influence, because they are closely interrelated. In the course of research on the crop under study, the influence of factors is observed not only on their growth and development, but also on the formation of the crop and its quality.

Sweet sorghum is tolerant of critical drought, has the ability to preserve biomass during prolonged dry weather, and economically consumes soil moisture throughout the growing season during the formation of vegetative and generative organs. Therefore, this crop is an acceptable silage crop in dry conditions, which provides good security for the uninterrupted in-line production of feed with a high content of feed units and digestible protein during the feeding period of animals. An important biological property and advantage of sorghum is continuous sowing without loss of yield, also sowing on slopes, eroded and saline lands.

Key words: *Biotechnology, bioactive compounds, sweet sorghum, productivity, forage crops*.

Introduction. In the last decade in Kazakhstan, especially in the southern region, dry periods have become more frequent, unfavorable for the cultivation of traditional forage crops. In this regard, attempts are being made to introduce crops that are more resistant to moisture deficit in the soil, such as: sorghum-sudangrass hybrid, sweet sorghum, millet, Sudan grass, pigweed, green foxtail, etc. [1,2].

Under the guidance of Doctor of Agricultural Sciences V.M. Makarov, for the first time in Kazakhstan, promising varieties of forage sorghum and breeding material of early ripening food sorghum were obtained in the selection and seed production laboratory of the Research and Production Center for Agriculture and Plant Growing [3].

In connection with the environmental situation in agriculture, researchers are studying new biotechnological approaches in the technology of growing crops to protect plants from pests and diseases, stimulate plant growth and development [4].

Biological farming currently occupies special attention. Biotechnologies for the production and use of biological products have been developed based on symbiotic and associative nitrogen-fixing microorganisms, as well as bioactive compounds, including microorganisms producing phytohormones, vitamins, organic acids, and antibiotics. For sowing sweet sorghum, a favorable period is considered to be when the soil temperature is warmed up to +18...+20 °C, with a sowing rate of 250 thousand varieties. seeds/ha. Favorable collection of green mass and dry matter can be obtained when harvesting in the phase of waxy ripeness of grain, while it is possible to maintain the dynamics of increasing sugar content and quality indicators of juice in connection with fertilizing with nitrogen fertilizers on two backgrounds of soil supply with mobile phosphorus, depending on the biological characteristics of sweet sorghum varieties [5].

Sorghum has a wide range of uses and is ranked third in the world as a food plant after wheat and rice. Grain is a valuable feed for livestock and a raw material for the feed, starch, syrup and alcohol industries; It is used as a grain crop in the preparation of cereals and bread. Post-grass is used for green fodder or can be used for grazing. 100 kg of sorghum grain contains 119 feed units, 100 kg of green mass - 23.5 feed units, silage - 22.0 feed units, hay - 49.2 feed units [6,7,8]. The use of syrup in the baking industry has shown that when baking rye-wheat breads, sugar can be completely replaced without reducing the quality of the bread. In the production of marmalade, sugar can be replaced with sweet sorghum syrup up to 10%, marmalade candies - up to 6%, pipenan - up to 40%. A further increase in the content of sweet sorghum syrup in products led to a deterioration in their quality.

Sorghum is used as a shrub plant for snow retention and protection of crops from dry winds. Sorghum as a row crop is a good precursor to spring crops.

Sorghum has high drought resistance and is a valuable crop not only for the arid regions of Kazakhstan, but also in Central Asia, the North Caucasus and Transcaucasia, southern Ukraine, Moldova, the Lower Volga region, and the Don.

An important biological property and advantage of sorghum is continuous sowing without loss of yield, also sowing on slopes, eroded and saline lands. Sorghum grain contains 12-15% protein, 3.4-4.4% lipids, 70-80% nitrogen-free extractable substances, 2.4-4.8% fiber. In terms of feed advantages, sorghum grain is not inferior to and even superior to barley. However, in the conditions of the region under study, the productivity potential of this crop is not fully realized. To obtain high yields of sorghum, it is necessary to develop methods and technologies for cultivation in general, including the selection of varieties, the choice of sowing methods and seeding rates, the use of fertilizers and herbicides.

Sweet sorghum is tolerant of critical drought, has the ability to preserve biomass during prolonged dry weather, and economically consumes soil moisture throughout the growing season during the formation of vegetative and generative organs. Therefore, this crop is an acceptable silage crop in arid conditions, which provides good security for the uninterrupted in-line production of feed with a high content of feed units and digestible protein during the feeding period of animals. This crop is also an important insurance crop in conditions of drought in the first half of summer, as well as in case of poor overwintering of winter crops [9,10,11].

The nutritional value of sorghum grain is quite high. In terms of protein content, sorghum has no equal among other forage crops. Sorghum grains contain 12-15% protein, about 70% starch and 3.5-4.5% fat. One centner of grain contains from 118 to 130 feed units. The energy value of the sorghum crop is 18.3 MJ per kg. Sorghum is effectively ensiled up to one and a half months after the onset of the optimal phase (milk-wax) of grain ripeness, which increases its importance for farms that have limited harvesting equipment and transport equipment. Thanks to good regrowth after grazing, the crop can be used to create annual pastures. The leaves and stems of the plants remain juicy until the grain is completely ripe. 100 kg of sorghum silage contains 20-24 feed units and 1.31-1.67 kg of digestible protein. The high sugar content in the stems makes it possible to obtain molasses and syrup, which can act as a substitute for beet sugar in the production of various products.

Along with varieties, high yields of grain and green mass are determined by cultivation technology, among which the decisive agrotechnical methods are timing, sowing methods, seeding rates, mineral nutrition and moisture supply. When the soil warms up to +14 - +16°C, sorghum shoots appear on the 10-12th day, and when the soil temperature rises to +25 - +28°C, shoots can be observed on the 5-6th day after sowing.

To solve the problem of increasing the yield of sorghum, it is necessary to develop general methods and cultivation technologies based on determining the methods and norms of sowing, selecting varieties, and using fertilizers and herbicides to protect crops from weeds. In the last decade, in our country, especially in the southern region, dry periods have become more frequent, unfavorable for the cultivation of traditional feed crops. In this regard, sorghum-Sudan wheat, sweet sorghum, millet, Sudan grass, amaranth, chumiza, etc. Attempts are being made to transplant crops that are more resistant to moisture deficiency in the soil. Today, solving the listed problems of the new crop of the sugar zone in the research area is very important.

Research materials and methods. Experimental studies were carried out in 2020-2022 on the territory of the educational and experimental site of the Research Institute "Ecology and Biotechnology", the Regional Testing Laboratory "Structural and Biochemical Materials" of the engineering profile of the South Kazakhstan University named after M. Auezov. The experimental site is located in the foothill-steppe zone and, according to climatic conditions, is typical for these conditions [12,13].

The object of the study is sweet sorghum variety “Kazakhstan 20”.

The research was carried out using generally accepted classical methods - experiment, test and observation. The two-factor field experiment was based on the method of split plots according to the method of experimental work, as well as the "Methodology for conducting agrotechnical field experiment" [14,15,16,17].

In the conditions of the arid South of Kazakhstan, the method of sowing and the number of plants per unit area is important. Proper placement of sorghum plants on an area is one of the most important conditions for obtaining guaranteed yields of green mass and sweet sorghum seeds. This issue has practically not been studied for the research area, therefore, in the experiments, sorghum was sown at rates of 150,250 and 350 thousand viable seeds per hectare with a row spacing of 0.15; 0.45 and 0.70 m. The sweet sorghum variety is characterized by good seed productivity, the yield of green mass is 800-870 c/ha. Plant height is 130-175 cm, high bushiness, develops intensively in the initial stage of growth, is resistant to standing, suitable for mechanized collection of green mass and seeds. The growing season from germination to the first cutting is 78-95 days, from sowing to full ripeness of the grain - 115-120 days. The variety is drought-resistant, responsive to humidity and has a high agricultural background. Recommended for cultivation in the regions of Zhambyl, Pavlodar, and South Kazakhstan regions.

The purpose of the research is to improve the use of biotechnological methods for growing sweet sorghum through the combined use of rational doses of nitrogen-phosphorus fertilizers and various bioactive compounds on serozem soils, in the dry steppe zone of Kazakhstan, under fire conditions.

Results and discussion. External conditions have both direct and indirect effects on economic growth. It is known that the rate of growth and development of plants depends on the intensity of physiological, metabolic and energy processes, air and root nutrition, moisture exchange, and when they change, the influence of external conditions can affect the growth rate. It should be noted that in natural conditions it is quite difficult to establish which of the factors may have an influence, because they are closely interrelated [18,19].

The study area is characterized by an average long-term annual precipitation of 262 mm and an extremely uneven distribution over the seasons. The largest amount of precipitation falls in the spring and winter periods (41.4 and 37.2%), the deficient period is summer with precipitation up to 3.8%, and in the autumn the precipitation falls up to 17.6%. The predominant part of atmospheric precipitation falls in the form of rain, the snow cover is unstable from 10 to 35 cm and can last up to 43 days. Winters are short, unstable and relatively cold; the average air temperature in January reaches -3 - -4 °C. The period with an average daily air temperature below 0°C is 45-65 days. Soil freezing reaches a depth of 20 cm, in cold winters - up to 60 cm. Relative humidity in the cold months is 81%. Spring is short, characterized by an intense increase in air temperature and maximum precipitation. Stable average daily air temperatures above 0°C are established, as a rule, in mid-February with fluctuations of up to 15-25 days in one direction or another. The onset of spring is observed in the last ten days of March and is delayed until the last days of April. The average air temperature in the warm spring period reaches up to +14°C with fluctuations from +12 to +20°C. The average monthly temperature in April is +15.1°C. Relative humidity is 60%, in May it drops to 50%. Summer is dry and hot with a stable average daily air temperature of +25.1°C, but on some days in the shade it can reach up to +45°C, and there is practically no precipitation. The average air temperature in July is +26.9°C, and the average monthly relative humidity in June-July decreases from 46-47% to 26%. During this period, winds from the north and northwest directions predominate. Thermal summer resources account for 80-85% of the total annual norm. Autumn is warm, the average air temperature is +11.7 °C. The first autumn frosts are in early or mid-October. The average monthly air temperature is +18.5°C, in November it sharply drops to +4.6-5.1°C. Relative humidity in September is 56%, and by November it rises to 74%. The winter-spring period maximizes the partial leaching of salts harmful to plants from the top layer of soil, which provides a supply of moisture in the soil, and in areas with close occurrence of desalinated or slightly mineralized groundwater contributes to an increase in the thickness of the desalinated top layer of groundwater - a "fresh cushion", created by autumn-winter leaching irrigation against the background of drainage. In some years, maximum precipitation occurs in April-May.

The temperature regime of the ecosystem for the crop under study was determined by the values of the average monthly air temperature (t°C) during the growing season of sweet sorghum in 2020-2023 research years (Table 1).

Table 1 – Duration of the growing season depending on the temperature regime in the zone of sweet sorghum

Years of research	Average monthly air temperature during the growing season of sorghum			∑ of active t° of the growing season of sorghum, t°C	Duration of the growing season for sorghum, in days
	during the years of research	according to long-term data	increase in air temperature by t°C		
2020	23.7	18.8	4.9	3205	114
2021	24.2		5.4	3315	116
2022	24.0		5.6	3270	110
Average over the years of research	23.8		5.0	3263	115

The biotechnology of cultivation of sweet sorghum was carried out on the basis of recommendations for resource-saving adaptive technologies of the zonal farming system for cultivating agricultural crops, which includes early spring harrowing in two tracks and two treatments with a KPS-4 cultivator in combination with KUST-8.8, as well as treatment with the same unit before sowing (the first to a depth of 0.11-0.12 m, the second - immediately before sowing to 0.05-0.08 m). Phosphorus fertilizers were applied in the fall during the main tillage period, nitrogen fertilizers were applied in full dose before sowing. According to the thermal regime during seed germination, sweet sorghum belongs to the III group of annual heat-loving crops, like corn, millet, and foxtail. Seed germination occurs when there is a certain amount of moisture and heat in the soil. The optimal temperature in the soil during the sowing period for seed placement is considered to be +12 - +15°C. After early spring harrowing in two tracks, the field was not cultivated until weeds appeared. The beginning of the emergence of mass emergence of weeds is usually noted in late April - early May.

During the years of the study, sweet sorghum seeds had high sowing qualities when sown. Before sowing, the seeds of sweet sorghum were subjected to solar heating for 5-7 days in open areas, laid out in a thin layer, 10-15 cm thick. During the day, the seeds were shoveled several times to increase the germination energy and germination rate by 0.5-1.5 %, which was further transformed into the activation of biochemical processes during their germination.

Experimental studies have shown the great importance of observing sowing dates when cultivating crops. The main factor in this case was the provision of favorable factors - humidity and temperature of the top layer of soil. Sowing was carried out to a depth of 10 cm at a temperature of +12 - +14°C in the second half of April, which determines the completeness of seedlings and the pace of the initial phases of growth and development. Also, one of the most important techniques when sowing sorghum is the correct observance of the seeding depth, sowing method and the number of plants per unit area, which makes it possible to obtain a guaranteed yield of green mass and sweet sorghum seeds. This technology has practically not been studied for the study area, therefore, in the experiments, sorghum was sown at rates of 150, 250 and 350 thousand viable seeds per hectare with row spacing of 0.15 m; 0.45 m and 0.70 m. The first inter-row treatment was carried out with clearly marked rows at a plant height of 6-8 cm, treatment depth - 8-10 cm, the second inter-row treatment was carried out in the phase of entering the tube (after 20-25 days), depth - 6-8 cm.

Harvesting sorghum for green fodder was carried out during the period of grain formation, since in the conditions of the research zone, obtaining a second cutting (return) is problematic, the forage is somewhat coarse, but is well eaten by animals.

The use of high-quality material, soil moisture, and soil thermal conditions determine the field germination of seeds. Based on the data obtained, it is possible to establish a certain relationship between the completeness of seedlings and the seeding rate, as well as between biologically active compounds and doses of fertilizers. An important condition for the formation of high yields of sorghum is obtaining even and timely seedlings, while maintaining optimal plant density, which is not an easy task in the arid conditions of the southern region. The obtained research results showed that individual methods of treating seeds with Selest Top, Gumi 20 and Potassium humate have different effects on the field germination of sorghum seeds. Treatment with drugs increases field germination to 16-18%. The varietal purity of sweet sorghum is high, but seed germination varies up to 82.5% (Table 2).

Table 2 – Yield of green mass of sweet sorghum, t/ha

Factor A – fertilizer doses, kg/ha of active ingredient	Factor B – bioactive compound	Yield, t/ha average	Deviation (+/-), t/ha	
			Factor A - biologically active substances	Factor B - nitrogen-phosphorus fertilizers
Kazakhstan 20				
$N_{30}P_{30}$	Control	11,7	-	-
	Selest Top	13,4	-	+1,7
	Gumi 20	13,7	-	+2,0
	Potassium humate	14,2	-	+2,5
$N_{60}P_{60}$	Control	13,2	+1,5	-
	Selest Top	14,8	+1,4	+1,6
	Gumi 20	15,4	+1,7	+2,2
	Potassium humate	15,9	+1,7	+2,7
$N_{90}P_{90}$	Control	13,9	+2,2	-
	Selest Top	18,0	+4,6	+4,1
	Gumi 20	18,2	+4,5	+4,3
	Potassium humate	19,3	+5,1	+5,4

Table 2 shows that the yield of green mass of sweet sorghum increases depending on the doses of nitrogen-phosphorus fertilizers and bioactive compounds. With N30P30 and Selest Top, the average yield was 13.4 t/ha; on N30P30 and Gumi 20 – 13.7 t/ha; N30P30 and Potassium humate – 14.2 t/ha. With N60P60+Selest Top, the yield was 14.8 t/ha, N60P60+Gumi 20 - 15.4 t/ha, N60P60+Potassium humate - 15.9 t/ha. When applying N90P90+Selest Top, the yield was 18.0 t/ha, N90P90+Gumi 20 – 18.2 t/ha and N90P90+Potassium humate – 19.3 t/ha. The influence of factor B on the formation of green mass of sweet sorghum increases when fertilizers are applied in doses of N60P60 and N90P90, which in combination with Selest Top gave an increase of 1.6 and 4.1 t/ha, in a companion with Gumi 20 the increase was 2.2 and 4.3 t/ha, with Potassium humate the increase was 2.7 and 5.4 t/ha on average over three years.

The influence of factor A at doses of N60P60 and N90P90 in the control amounted to an increase of 1.5 and 2.2 t/ha, in the experiment from +1.4 to +5.1 t/ha, depending on the type of biologically active substances and the dose of fertilizer.

Based on the data obtained, it can be established that the integrated use of bioactive compounds and nitrogen-phosphorus fertilizers has a positive effect on increasing the nutritional value and yield of sweet sorghum and green mass in general. The dietary supplements used consist of phytohormones (80%), as well as micro- and macroelements such as potassium, calcium, iron, boron, molybdenum, copper and others, which have a significant effect on the metabolism of growing seeds and have a positive effect on the vital activity of sorghum plants. subsequent stages of development. Selest Top is a natural biopolymer, the active ingredient of which is polybeta-hydroxy fatty acids obtained by isolating Pseudomonas aureofaciens and Bacillus megaterium from soil bacteria. The principle of action of potassium humate is based on the natural stimulation of the natural protective reactions of the plant. In addition, resistance to extreme temperatures, pesticide stress, soil contamination with chemicals, drought, salinity, frost and other stresses is increased. Gumi 20 contains biologically active phytohormones and microelements, as well as up to 2000 mg/l of fulva and juice compounds. The preparation also contains rhizosphere microorganisms and phytopathogens. Potassium humate is an effective growth stimulant, combining the properties of an anti-stress adaptogen, increasing the productivity and environmental friendliness of agricultural crops. Mainly humic acids and phytohormones with a high content of sodium and potassium humates 80%, which make it possible to provide energy for seed germination, and also stimulate the development of a powerful root system at the initial stage of development. Positive dynamics were observed in the production of sweet sorghum in all variants of feeding using biologically active substances. The application of mineral fertilizers significantly increased the growth and development of plants throughout the entire period of field research. Unfortunately, due to the low amount of available nutrients in the sulfur-soil industry of the belt, even with the use of biologically active substances, the yield of forage crops was not fully realized even in unfertilized optionsEconomic efficiency in cultivating sweet sorghum depends on the current market value, material resources and the level of products obtained. In addition, the value of the socio-economic factor, genetic characteristics and level of adaptability of the crop to specific soil and climatic conditions, the use of an innovative element of technology for the production of sorghum crops on gray soils in combination with biologically active additives and fertilizers

Conclusion. Sorghum is a valuable crop for the production of high-quality green mass and silage in the arid dry steppe zone of Southern Kazakhstan. In the studied region, sorghum is not inferior to corn in terms of dry matter yield and digestible protein collection, and is better able to demonstrate its ecological plasticity and effectively use soil and photosynthetic resources. When using well-established technology for cultivating sweet sorghum, it is possible to ensure high and stable yields. Thus, to solve these problems, we have studied and identified modern biotechnological methods and substantiated ways to solve the problem of increasing the productivity of sweet sorghum seeds in the conditions of Southern Kazakhstan through the use of biologically active compounds. The dependence of yield on biologically active substances, background use and mineral nutrition has been established; optimal doses of bioactive compounds and mineral fertilizers were determined on gray soils of Southern Kazakhstan.

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ТҮЙІН

Мақалада Оңтүстік Қазақстан жағдайындағы ыстыққа төзімді, құрғақшылыққа төзімді дақылдың өнімділік көрсеткіштері бар тәтті құмайдың зерттеу деректері келтірілген. Құмайдың қолдану аясы кең және тағамдық өсімдік ретінде әлемде бидай мен күріштен кейін үшінші орында. Астық – мал шаруашылығының бағалы азығы және жем, крахмал, сірне және спирт өнеркәсібінің шикізаты; Дәнді дақыл ретінде жарма және нан дайындауда қолданылады. Сыртқы жағдайлар экономикалық өсуге тікелей және жанама әсер етеді. Өсімдіктердің өсу және даму қарқыны физиологиялық, зат алмасу және энергетикалық процестердің қарқындылығына, ауа мен тамырдың қоректенуі, ылғал алмасуына байланысты болатыны және олар өзгерген кезде сыртқы жағдайлардың әсері өсу қарқынына әсер ететіні белгілі. Айта кету керек, табиғи жағдайларда факторлардың қайсысы әсер етуі мүмкін екенін анықтау өте қиын, өйткені олар өзара тығыз байланысты. Зерттелетін дақылды зерттеу барысында олардың өсуі мен дамуына ғана емес, дақылдың қалыптасуына және оның сапасына факторлардың әсері байқалады.

Тәтті құмай сыни құрғақшылыққа төзімді, ұзақ құрғақ ауа райы кезінде биомассаны сақтау қабілетіне ие және вегетативтік және генеративті мүшелердің қалыптасуы кезінде бүкіл вегетациялық кезеңде топырақтың ылғалдылығын үнемді түрде жұмсайды. Сондықтан бұл дақыл құрғақшылық жағдайында қолайлы сүрлемдік дақыл болып табылады, ол малдың қоректену кезеңінде азықтық бірлік пен қорытылатын протеиннің мөлшері жоғары жемнің үздіксіз линияда өндірілуін жақсы қамтамасыз етеді. Құмайдың маңызды биологиялық қасиеті мен артықшылығы – өнімін жоғалтпай үздіксіз себу, сонымен қатар беткейлерде, эрозияға ұшыраған және сортаң жерлерге себу.

РЕЗЮМЕ

В статье представлены данные исследований сахарного сорго с показателями урожайности, жаростойкой, засухоустойчивой культуры в условиях Южного Казахстана. Сорго имеет широкий спектр применения и занимает третье место в мире как пищевое растение после пшеницы и риса. Зерно является ценным кормом для скота и сырьем для кормовой, крахмало-паточной и спиртовой промышленности; в качестве зерновой культуры применяют в приготовлении крупы, хлеба. Внешние условия оказывают как прямое, так и косвенное влияние на экономический рост. Известно, что скорость роста и развития растений зависит от протекания интенсивности физиологических, обменных и энергетических процессов, воздушного и корневого питания, влагообмена и при их изменении влияние внешних условий может оказывать воздействие на скорость роста. Следует отметить, что в природных условиях достаточно сложно установить какой из факторов может оказать влияние, потому как тесно взаимосвязаны между собой. В ходе исследований изучаемой культуры наблюдается воздействие факторов не только на их рост и развитие, но и на формирование урожая и его качество.

Сахарное сорго вынослив к критической засухе, при летней длительной засушливой погоде имеет качество сохранять биомассу, в течение всей вегетации при формировании вегетативных и генеративных органов экономно потребляет почвенную влагу. Поэтому данная культура в засушливых условиях является приемлемой силосной культурой, что дает хорошую обеспеченность при бесперебойном поточном производстве кормов с повышенным содержанием кормовых единиц и перевариваемого протеина в период кормления животных. Важным биологическим свойством и преимуществом сорго является бессменный посев без потери урожайности, также посев на склонах, эродированных и засоленных землях.

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ЖЕРДІ БАЗАЛЫҚ СТАНЦИЯ АРҚЫЛЫ БАҚЫЛАУ, ӨЛШЕУ НЕГІЗІНДЕГІ ӘДІСТЕРДІ САЛЫСТЫРУ ЖӘНЕ ОЛАРДЫ ЖЕРГЕ ОРНАЛАСТЫРУДА ҚОЛДАНУ
OBSERVATION OF THE EARTH THROUGH THE BASE STATION, COMPARISON OF MEASUREMENT-BASED METHODS AND THEIR APPLICATION IN LAND MANAGEMENT